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PIPE LINE INDUSTRY

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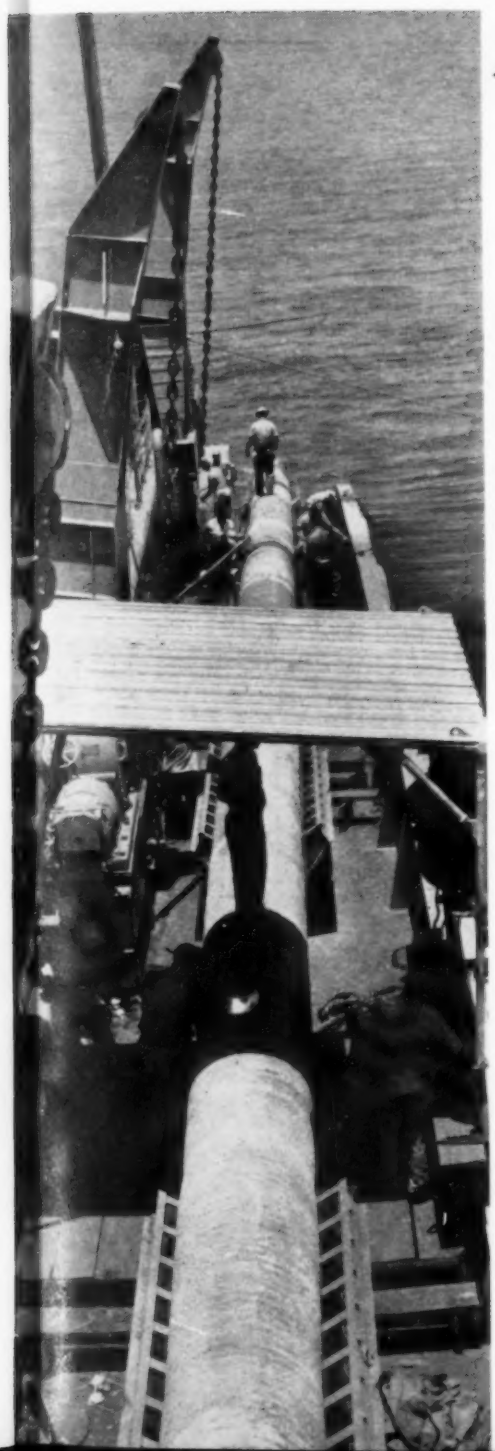

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PIPE LINE INDUSTRY

CONTENTS and Quick Look

July, 1958 Vol. 9, No. 1

To help you put first things first, scan these time-saving digests, checking ☑ those you want to read first.

Barge Minor Makes 214 Joints a Day

☐ Brown and Root's new giant speeds pipe handling, line-up and welding with automatic stalking rack. Davits over the pipe launchway, a specially designed hull, full deck coverage with rail-mounted gantry crane, plus many other design advances enable it to lay pipe in rougher weather and deep water.

By Melvin A. Judah.....Page 26

Combustion Air Conditioning—a Step Forward in Engine Design

☐ Combustion air conditioning is economically justified on engines of higher specific output and low fuel consumption. The engine with cooled air has lower specific fuel consumption and 33 percent greater specific output than the latest type non-cooled compressor engines.

By W. R. Crooks.....Page 31

Strain Gages Check Stress in Bridge Piping

☐ Texas Illinois engineers installed a network of resistance type strain gages on bridge carrier piping, downcomers, and approach bends on the company's dual 30-inch Mississippi River bridge to study vibration and secondary stresses. Data have been recorded for over 18 months in the three-year study.

By A. G. Barkow and D. E. Clark.....Page 36

Ten Tips on Ripping

☐ Heavier and more powerful tractor-ripper combinations are cutting ditching and clearing costs in many kinds of terrain. Here are some of the ideas pipe line contractors have come up with to handle tough conditions.

By J. J. Keyes.....Page 40

Chart Simplifies Dew Point and Hydrate Formation Problems

☐ Here in one plot is a compilation of water content data for natural gas covering the range of experimental conditions from atmospheric pressure up to 10,000 psia and temperatures from —50° F. to 300° F. Correction factors are also plotted for gravity and salinity of reservoir waters.

By John J. McKetta and Albert H. Wehe..Page 41

Let's Look at Rectifier Efficiencies

☐ Major sources of energy loss in a cathodic protection rectifier are cell losses and those losses resulting from ripple power characteristics. These efficiency calculations will spot potential power losses and show ways to get the most protection for your power dollar.

By Ray M. Wainwright.....Page 43

Open Air Pump Stations Cost Less to Build, Are Cheaper to Maintain

☐ Outdoor pump stations have proved to be safer than indoor installations where combustible mixtures of gas and air are more likely to accumulate. Modern equipment is now available which has a high degree of reliability for exposed service and minimum maintenance. Although more expensive, the added cost is more than offset by savings in cost of buildings.

By A. L. Crichton.....Page 47

Lick Those Technical Writing Problems

☐ At last, here is an article which recognizes that there are difficulties involved with technical writing that belong to no other. In normal, everyday language, precise details tend to make writing vivid. Technical words such as horsepower are also specific, but they evoke no visual image. Here is a procedure, however, which will make your technical writing come easier, and your reports more readable.

By W. A. Sylvester.....Page 50

How Do You Rate as a Conference Leader?

☐ Leadership can mean the difference between a fruitful meeting and one which accomplishes absolutely nothing. Here is a checklist which you can use to evaluate and improve your leadership techniques. It's a must for those who plan to conduct a business conference.

By Dr. Robley D. Stevens.....Page 53

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Destroying Ourselves

THE RECENT INDICTMENT of 29 oil companies for price conspiracy is another example of the growing tendency in the U. S. to harass and cripple business for temporary political gain.

When the Suez Canal blockade shut off Middle East oil shipments to Western Europe, President Eisenhower asked U. S. oil companies to do everything within their power to provide enough oil to keep our Western Europe allies from freezing and to keep factories and transportation systems operating.

Oil companies rose to the occasion in admirable fashion. They used such expensive extremes as moving pipe line pumps, reversing pipe line flow and circuitous routing, even shipping oil overland from West Texas to St. Louis, then down the Mississippi River to the Gulf of Mexico. At one time shipments from the U. S. to Western Europe reached a million barrels daily. The result was that Western Europe experienced little inconvenience.

In "gratitude" for this magnificent effort, the U. S. government has proceeded to inspire a grand jury indictment against 29 oil companies on the ground that "beginning sometime in 1956 and continuing through January, 1957, the 29 oil companies engaged in an unlawful combination and conspiracy to raise, fix and stabilize the prices of crude oil and automotive gasoline."

THE INDICTMENT DELIBERATELY IGNORES the basic laws of supply and demand under a free business economy. Otherwise, the charges never would have been filed.

Total demand for U. S. oil rose from 8.7 million barrels per day in September, 1956, to 11.4 million barrels in January, 1957. During this period, export shipments to Western Europe rose from 350,000 barrels per day to slightly more than 1 million barrels daily.

It is natural under a free business economy for prices to fluctuate with sharp increases or decreases in demand. And, that is just what oil prices did.

Wholesale cargo prices for regular gasoline along the Gulf Coast averaged 10 cents per gallon in late 1956. During the peak of the European lift in early 1957, these prices averaged 11.1 cents per gallon. Crude oil prices rose 25 to 35 cents a barrel. (This was the first substantial increase in crude oil and gasoline prices since 1953, although cost of materials and labor had resulted in sharp gains in operating costs).

The grand jury conveniently did not extend its investigation beyond January, 1957. Demand for U. S. oils dropped sharply following reopening of the Suez Canal to Middle East oil shipments. And, the wholesale gasoline price in the Gulf Coast fell to 9.9 cents per gallon by February, 1958—less than it was before the Suez crisis.

THIS INDICTMENT of 29 U. S. oil companies on such unreasonable grounds fits the now familiar "kick business on the shins" political philosophy like a glove. (Incidentally, two of the companies indicted are involved in litigation in Iraq for cutting Iraq crude prices 5 cents a barrel in 1956.)

Such attacks on business are becoming all too common in the U. S. Unless checked, they are sure to soften the American free enterprise business system for the socialistic kill. This can mean only one thing: the destruction of the whole American way of life.

This and similar actions (the Memphis decision, control of producer gas prices, and several recent oil industry Congressional investigations) are contrary to the American way of life in that they:

1. Place party politics above maintaining a healthy national economy.

2. Fail to recognize that prices are based on supply and demand under the American business system.

3. Ignore the need for business to earn a profit, and thereby attract investment funds with which to continue to expand and create additional jobs for this country's growing population.

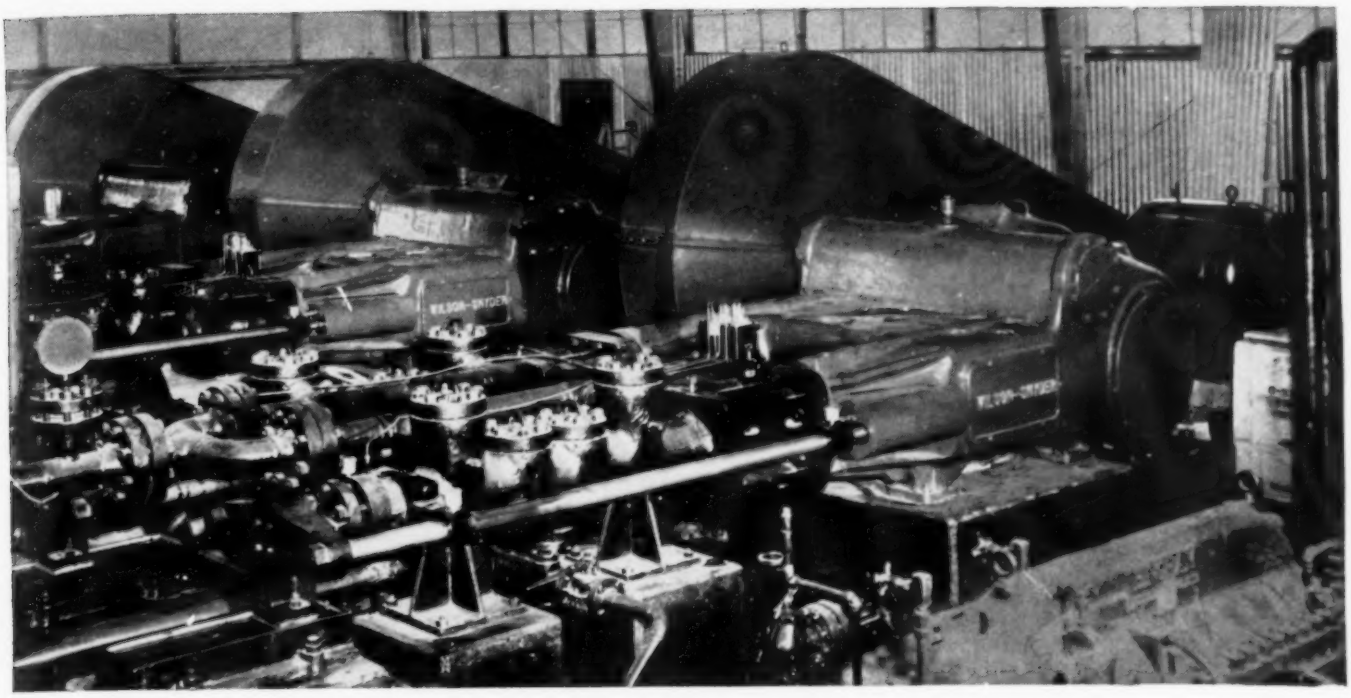
4. Studiously ignore the inflationary increases in postwar material and labor costs.

5. Constantly harass industry with investigations, criminal charges, and crippling legislation until progress is out of the question.

6. Rip industry apart in the eyes of the public.

OUR ELECTED POLITICIANS should be able to find constructive things to do in these trying times. Surely, they do not need to be destructive, which is what they are doing when they continually kick the business system that has contributed so much toward making this country outstanding in the history of the world.

Warren L. Baker



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ALTHOUGH the pumping of slurries continues to present specific problems for every project, Wilson-Snyder has, for many years, been building pumps which excel in that kind of service.

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Fortified with much practical experience, Wilson-Snyder pump engineers know the basic problems in applications of this type and are more than willing to discuss them with you. We can give you valuable assistance in the application of slurry pumping equipment and show you the outstanding features of Wilson-Snyder pumps that are available for a wide range of displacements, working pressures, and fluid-end designs and materials.

Of course you'll want specialized engineering assistance for installing any slurry pumping project, but during the planning stages it just makes good sense to take advantage of our experience and testing facilities. Just write to:

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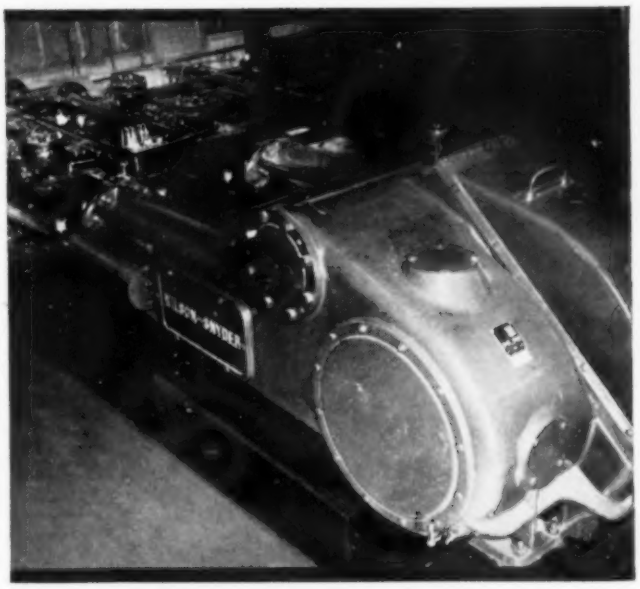

AMERICAN GILSONITE COMPANY'S pumping station at the Bonanza, Utah mines relies upon three (two operating, one stand-by) Wilson-Snyder heavy-duty plunger pumps to move 630 tons of Gilsonite per day through the 72-mile pipeline for processing near Grand Junction, Colorado. Each pump is powered by a 300-hp motor and the system is capable of handling 325 gpm of slurry at 2200 psi.

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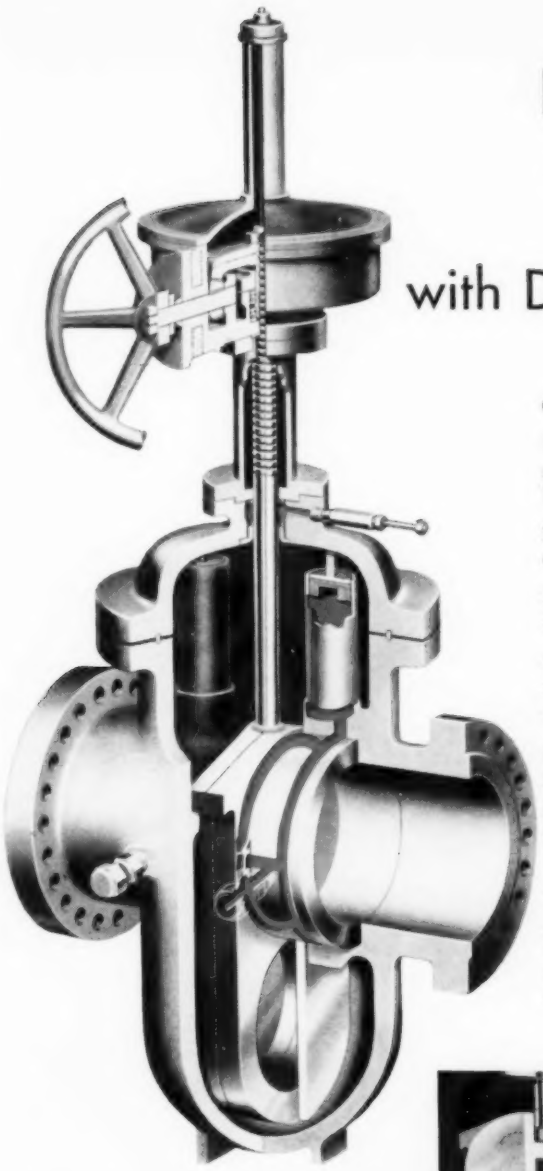
Indexed by Engineering Index

NEW ADVANTAGES "GO ON THE LINE"

with DARLING-McEVOY Conduit Valves



Compare these features with *any* other pipe line gate valve:

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2. **NON-DIRECTIONAL.** Flow may be in either direction. Sealant cylinders operate independently.

3. **TWIN SEALANT RESERVOIRS.** One for each port. Sealant feeds automatically to downstream side only.

4. **NEGLIGIBLE SERVICING.** Leak-proof closure requires very little sealant. Reservoir capacity ample for 50 to 80 operations dependent on differential pressures.

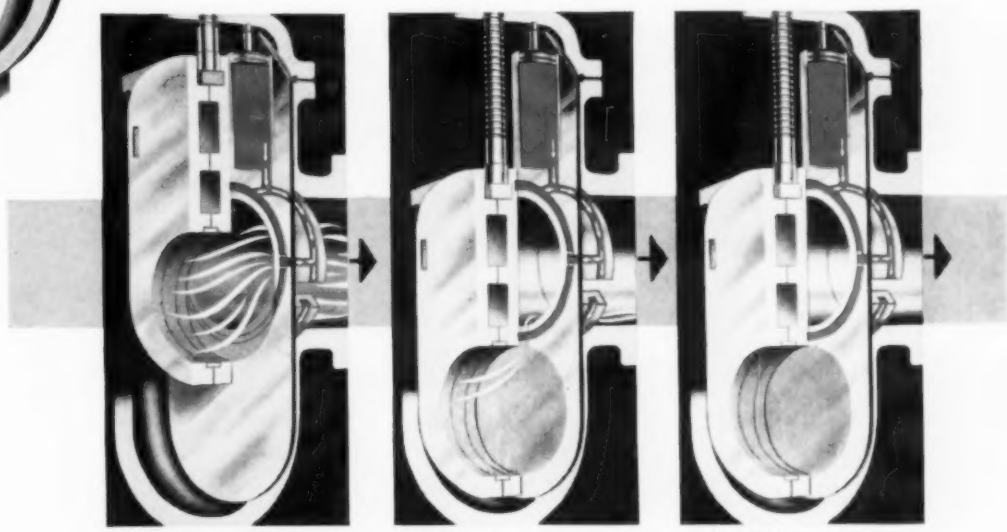
5. **SMOOTH, FULL FLOW.** No impediments. No turbulence. No pockets to collect sediment.

6. **EXCEPTIONAL PERFORMANCE AND LIFE.** Self-aligning gates. No wedging. Non-distorting seats, protected when valve is open or closed.

Darling-McEvoy conduit valves, made in 4" and larger sizes, are fully field proved and are now operating continuously on various major lines. For complete information on the self-sealing feature and many other advantages of this unique valve, ask for Bulletin 5402.

Above: *Cutaway showing heavy, self-aligning gate and parallel seat assembly, with one of the two sealing systems indicated.*

Right: *Diagrams of closure action on downstream side of gate.*



APPROACHING CLOSURE... *No loss of sealant as sealing groove in seat is disconnected from reservoir until gate is fully closed.*

CLOSED ... *Jumper in gate now permits differential pressure to feed sealant into seat groove to check any remaining flow.*

AUTOMATICALLY SEALED. *Pressures again in balance. Tightness established. No additional sealant used until again needed.*

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DRILLING IN ARIZONA — Here Cape Construction Co. uses its MD7 for a drilling operation on a 24-inch crude oil line, running from Four Corners to Los Angeles. In rough going, pipe is being put in the ground at a rate of 2 miles a day. "We rely on Cat-built Pipelayers to get the job done," says Garland Mims, spread superintendent.

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They're good, says Hood

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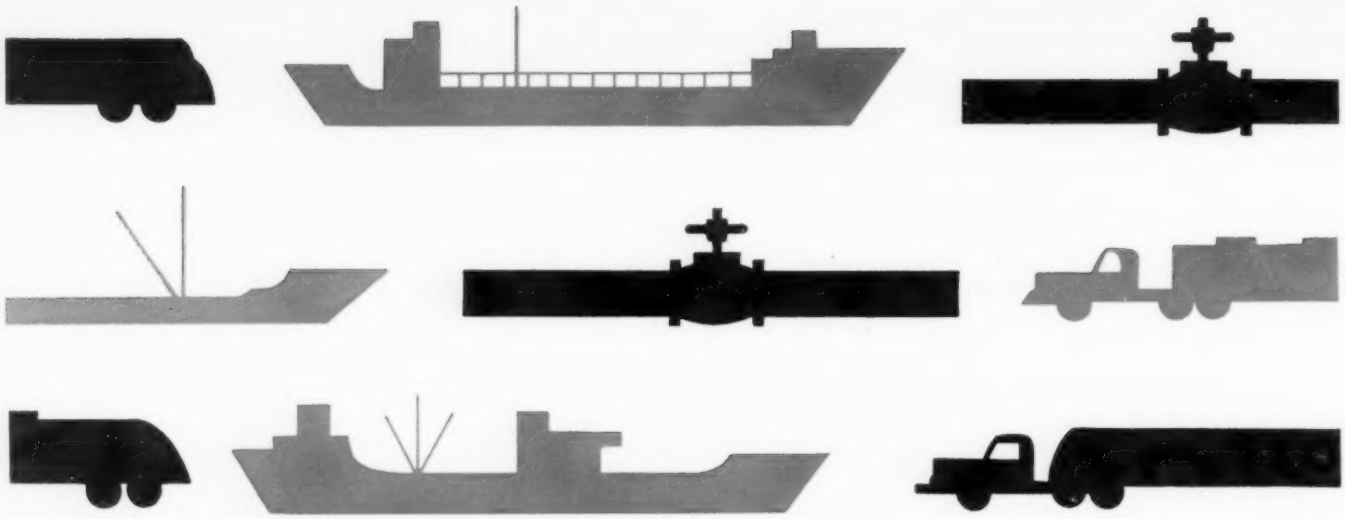

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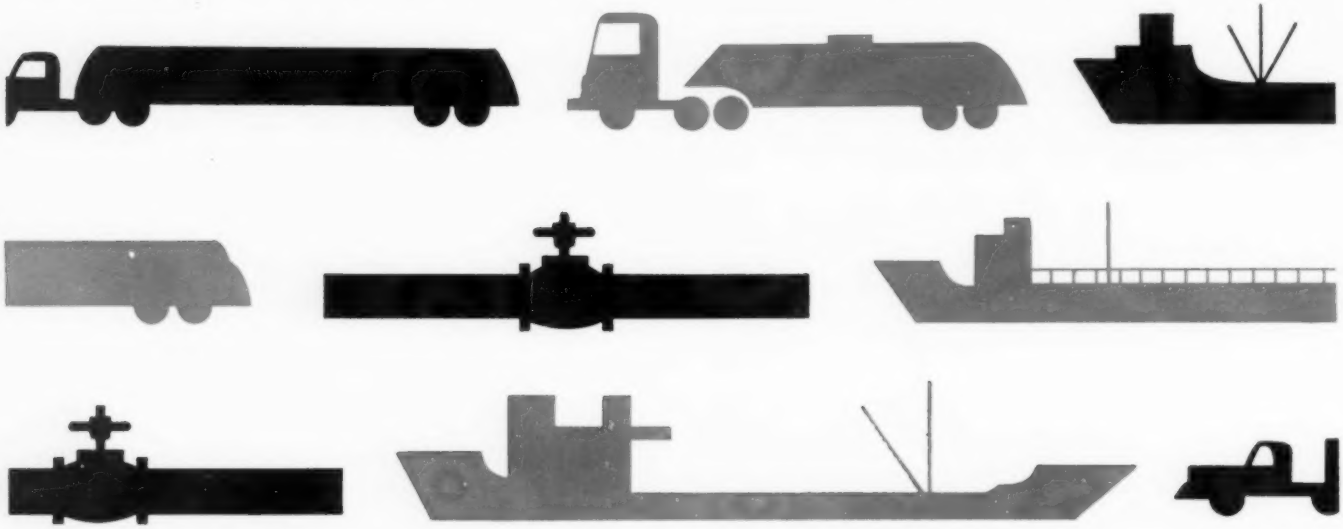

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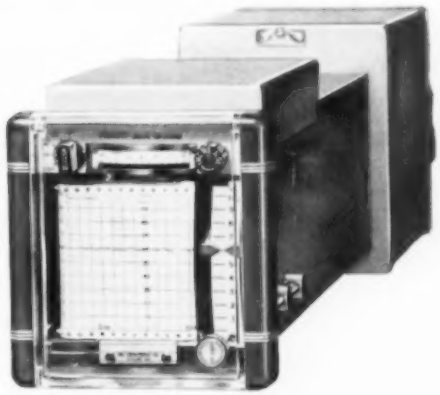

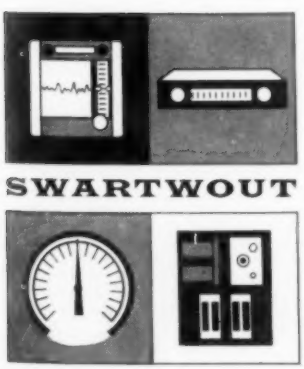

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Pipeliners in a hurry beat tight schedules

...with Planet Power-

Laying a loop of 36-inch line near Kernersville, North Carolina, Western Construction Company, Austin, Texas, beats its schedule day after day—hills or no hills! On this job for Transcontinental Gas Company, International TD-24 Crawlers were "booming" 6000 feet of big pipe per day for cleaning and priming—instead of the 4,500 feet called for. Other International Superior units were pacing the stringing and tie-in work.

- steered TD-24 sidebooms!

"TD-24's are schedule keepers"

"I find dependable TD-24 sidebooms always enable me to maintain the doping schedule, under all terrain conditions," states M. W. Blue, foreman of doping operations. "I like TD-24 Planet Power steering for keeping pipe alignment while carrying, especially in hilly terrain."

For precision pipe-handling control, uphill or down, exclusive TD-24 Planet Power steering lets you feed full-time "live" power to both tracks. You turn smoothly, as sharply or gradually as desired—without jerks! Exclusive TD-24 finger-tip hydraulic braking and foot decelerator give positive pipe-carrying control. And the exclusive TD-24 margin of flotation means bog-beating emergency action traction.

Prove the 130,000 lb. lift capacity—and all the other spread-speeding International Superior TD-24 sideboom advantages. Measure the downtime-prevention value of exclusive wear-saving fleeting sheaves. See your International Superior Distributor for a demonstration!

These two International Superior TD-24 sidebooms have the key assignment of handling big lengths of the 36" pipe for the clearing and doping crew. Operators have the exclusive super-safety and operating ease of reach-easy controls in vertical cluster!

International Harvester Company, Chicago 1, Illinois

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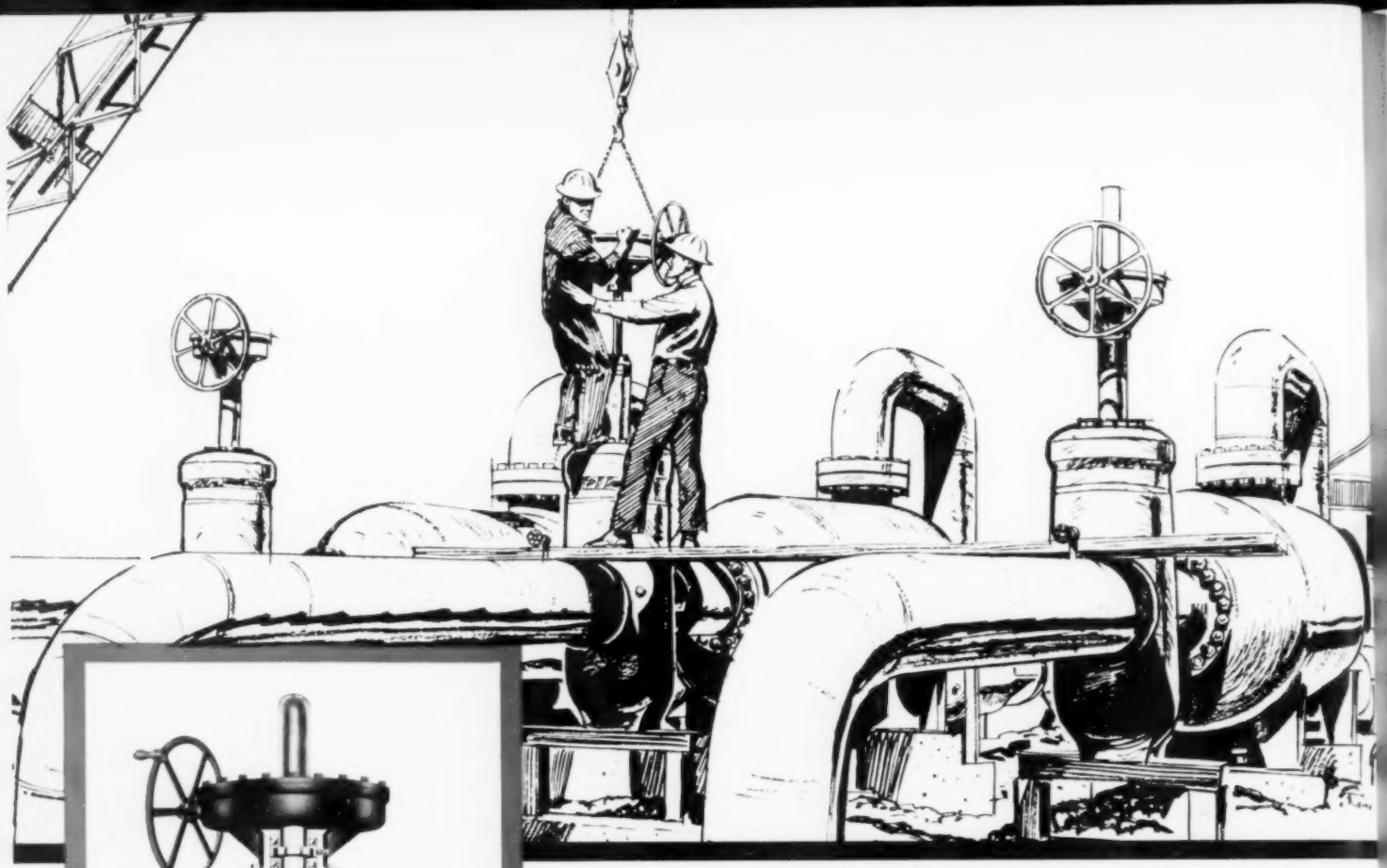

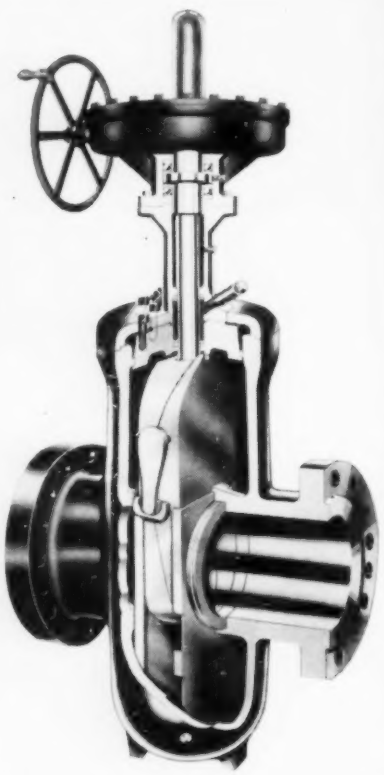

Creatively Engineered

W-K-M ASA Gate Valves

Painstaking attention to every detail of production, assembly and testing is your assurance that the performance of W-K-M valves will meet—and exceed —specifications.

Basic W-K-M design permits on-the-line overhaul with speed and economy

W-K-M Valves can be completely overhauled on the line. Gate, seats, skirt, bonnet, and all other parts can be removed from the body without difficulty or excessive shut-down, and in less time that it would take to remove the valve from the line. Replacement of parts puts the valve *in its original condition*. You save both time and money.

Other advantages: Full-bore, through-conduit design eliminates turbulence and pressure drop. W-K-M valves provide no-surge operation and permit free passage for pigs or scrapers. Easy operation is assured by W-K-M's patented gate centralizer.

On Hand

W-K-M ASA Gate Valves are available for an extremely wide range of applications. Your supply store has the most-used sizes. Larger sizes, in desired body and trim materials and end connections, are promptly supplied on order.

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Along the new highways . . .
ROSKOTE DOES THE JOB WITH SPEED!

Fast drying that permits overcoating or wrapping in a half hour steps up the protective coating phase of new pipeline construction on the jobs where speed is essential — along the nation's new network of highways.

A good example is this 8000 foot stretch of new 8" pipe along the new Southside Expressway in downtown Charleston, W. Va. It was installed recently for the United Fuel Gas Company by Saul and McCallister, Inc., of Yawkey, W. Va.

This contractor found that two men, using the Roskoter for application of Roskote 612 XM cold-applied pipe mastic, could keep pace nicely with the welders. The coating specifications called for over-the-ditch cleaning, two 15 mil applications of Roskote 30 minutes apart, followed immediately by wrapping with 15 lb. perforated asbestos pipeline felt.

Roskote 612XM is a cold-applied, fast-drying pipe mastic of high electrical resistivity. Composed of high grade native pyrobitumens homogenized with quality aromatic solvents and inhibitive pigments, Roskote is also highly resistant to corrosion by acid, alkali and salt. It dries to a tack-free film in 30 minutes or less. It is unaffected by temperature from sub-zero to 250° F. It will not oxidize, scale or check, and it bonds readily to previous coats of Roskote, coal tar or asphalt.

Non-toxic and non-irritant, Roskote may be applied by brush, glove, spray or Roskoter. The latter is seen in use in the photograph.

The Roskoter, one of the simplest means of coating pipe known, is also the most effective. It actually "bathes" the pipe in mastic as an extra safeguard against pinholes and other coating irregularities. And it gets the undersurface and other hard-to-see spots, often missed. Coating with the Roskoter can usually be handled by one man.

Roskote Cold-Applied Pipe Mastic enjoys the confidence of over 400 utilities and pipeline companies. For complete technical data and prices, write your nearest Royston office.

Royston Laboratories, Inc.
Box 112-D, Blawnox,
Pittsburgh 38, Pa.

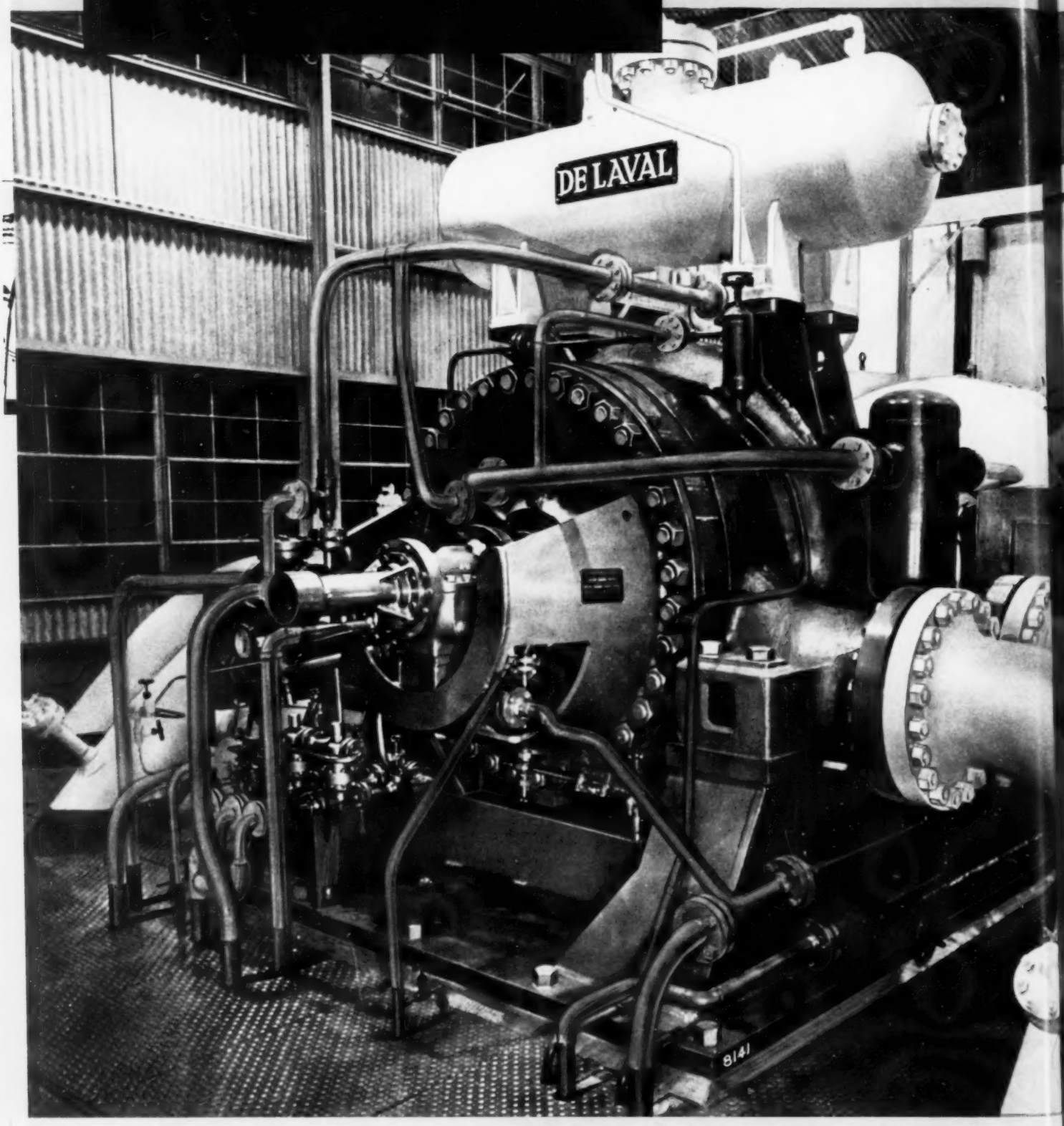
ROSKOTE

BRANCH OFFICES IN ATLANTA, CHICAGO, HOUSTON, PHILADELPHIA, SAN DIEGO AND TULSA. WAREHOUSED IN NORTHEAST, SOUTHEAST, NORTH CENTRAL AND SOUTH CENTRAL REGIONS.

A LEADER IN THE FIELD OF INDUSTRIAL COATINGS FOR CORROSION CONTROL.

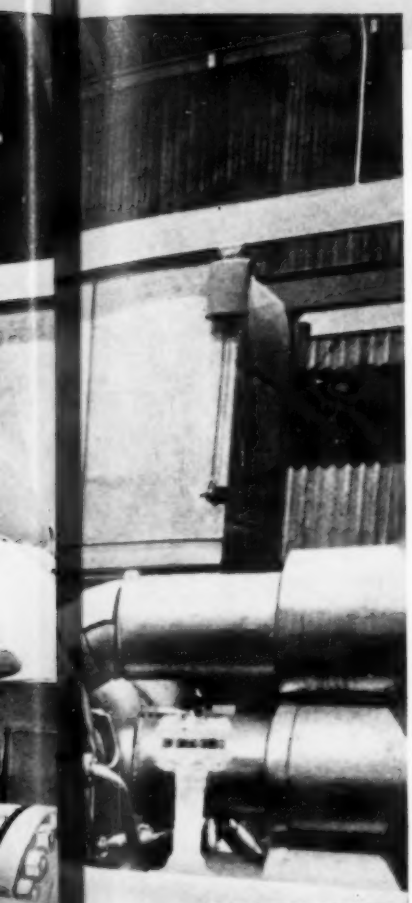
DE LAVAL
Series-Parallel
CENTRIFUGAL COMPRESSORS

provide extra fle



This De Laval Series-Parallel 6,350 hp centrifugal compressor is giving round-the-clock service in the Edna Station of the Trunkline Gas Company. Two other identical De Laval S-P units are doing a dependable job in the Kountze and Premont, Texas stations of this natural gas transmission system.

ra flexibility for Trunkline Gas Company

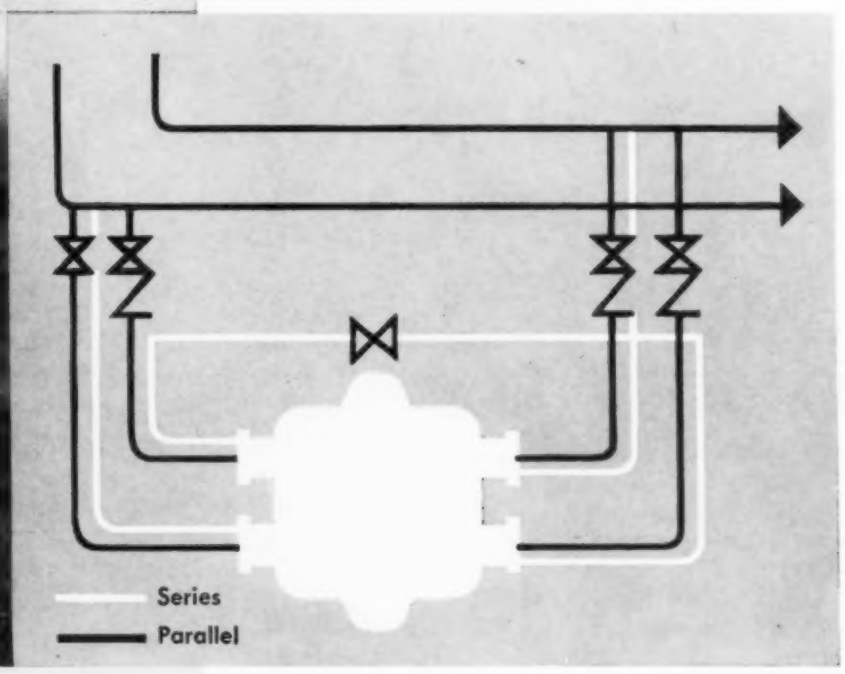


Booster station service demands flexibility in pipeline compressor design, which is available to a considerable degree in the standard De Laval single stage pipeline compressor. Some applications, however, require an exceptionally wide range, and the De Laval Series-Parallel centrifugal compressor has been designed to meet that need.

A good example is the De Laval Series-Parallel 6,350 hp compressor, shown in the photograph at left. It is one of three identical units serving booster stations of the Trunkline Gas Company.

S-P compressors are multi-stage units with the impellers arranged in two groups. Two inlet nozzles permit operating the impeller groups in series or in parallel as shown in the flow diagram. Within the horsepower limits of the driver, the compressor can be transformed from a high-flow, low-head machine to a low-flow, high-head unit *simply by operation of the external valving*. No changing of parts, not even a shutdown is necessary.

The reliability and economy of De Laval centrifugal compressors have been proved in natural gas transmission service throughout the country. You will find it pays to look to De Laval . . the company that has specialized in the development of these units. De Laval pipeline compressors are operating in sizes from 2500–15,000 hp and with all types of drivers—gas turbines, gas engines, steam turbines and electric motors.



For additional information, write for the article "Tailoring Centrifugal Compressors for Pipe Lines" as well as De Laval Bulletin 503.

DE LAVAL *Centrifugal Compressors*

DE LAVAL STEAM TURBINE COMPANY

884 Nottingham Way, Trenton 2, New Jersey

Built Clean And Tough--
To Keep Your Spreads On Schedule

Bucyrus-Eries are built clean, tough and simple . . . are easy to service and maintain even when you're miles from a full service crew!

Bucyrus-Erie pipeline hoes are "Hi-Walkers" because they're equipped with tractor type crawlers. They give you plenty of clearance for working over roughest ground. Deep grousers take hold, keep your machine moving in muck and on slopes. Sealed bearings keep sand and dirt out of track rollers to cut maintenance.

Long, cambered booms give the operator plenty of reach . . . let him dig in closer, trenching or trimming. Big clutches run smooth, automatically adjust themselves for temperature changes.

On spreads all over the country, Bucyrus-Erie "Hi-Walkers" set the pace that keeps pipeliners ahead of schedule. See your nearby distributor today and find out more about the ½-yd. 15-B and the ¾-yd. 22-B. 531E58

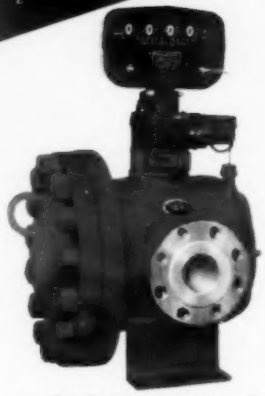
A Familiar Sign... BUCYRUS ERIE *. . . at Scenes of Progress*

BUCYRUS-ERIE COMPANY • SOUTH MILWAUKEE, WISCONSIN

Record NET metered gallonage—

Brodie Automatic Temperature Compensator, shown with Brodimatic Printing Counter, automatically corrects reading to net 60 F volume during run.

BRODIE AUTOMATIC TEMPERATURE COMPENSATOR with full range GRAVITY SELECTOR



- Automatically corrects counter reading to net volume which liquid would measure at 60 F
- Compensates for changes in both line fluid and ambient temperature effects over wide range
- Easily adjusted to precise expansion coefficient of any petroleum product or crude
- Available with single net counter, or dual counter to provide both net and gross readings
- May be used with Brodie Accumulator System to record total thruput of two or more Brodie Meters in series
- For pipelines, loading racks, blending, LACT systems, and refineries

B-65D *BiRotor* Meter with Automatic Temperature Compensator and Gravity Selector, Brodimatic Counter.

Corrected net gallonage figures can be taken directly from the counter readout or printed ticket – further extending the advantages of the sustained accuracy of Brodie *BiRotor* Meters. The Brodie Automatic Temperature Compensator with Gravity Selector is now thoroughly proved through a wide range of field applications. For the complete story, see your nearest Brodie Metering Specialist, or write today for Bulletin No. 652.

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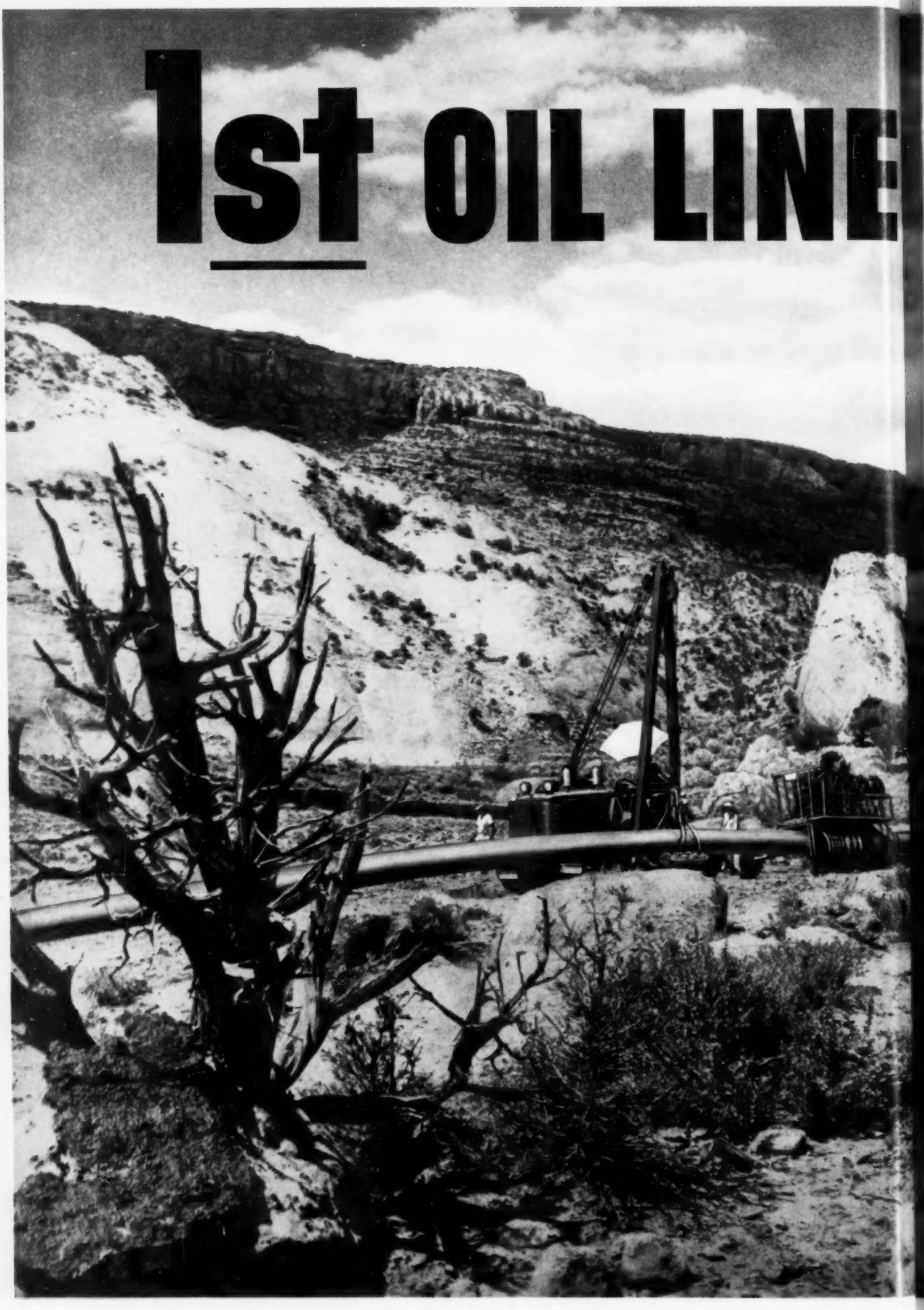

1st OIL LINE

TO CALIFORNIA

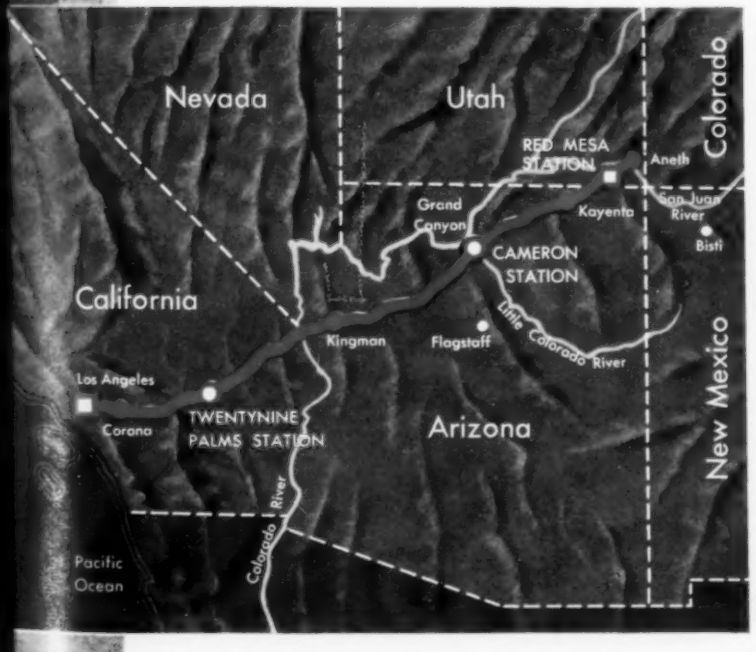
The Four Corners Pipe Line is the first line ever built to supply California refineries with oil from outside the state

Shell Pipe Line Corporation, acting as agent for the Four Corners Pipe Line Company, designed, constructed and will operate this important 16-inch line. The line itself will be owned by six companies — Continental Pipe Line Company . . . Gulf Oil Corporation . . . Richfield Oil Corporation . . . Shell Oil Company . . . Standard Oil Company of California . . . and Superior Oil Company.

The purpose of the line is to tap reserves of 250 to 500 million bbls. to meet anticipated expansion in California's economy.

A. O. Smith furnished more than 600 of the 637 miles of 16-inch main line that runs from Aneth, Utah, to Los Angeles.

For almost 30 years . . . A. O. Smith line pipe has always been manufactured to a high standard of quality . . . precisely controlled at every step of production. That's why A. O. Smith pipe, made and installed in 1928, is still in operation. That's why so much A. O. Smith pipe is found in every important pipeline project.



From Aneth, Utah, to metropolitan Los Angeles, the line surmounts many obstacles. They include—elevations ranging from sea level to 6700 feet . . . deserts . . . three major river crossings . . . 200 miles of solid rock . . . and daily temperatures fluctuating between 40 and 120° F.

Through research A.O. Smith *. . . a better way*

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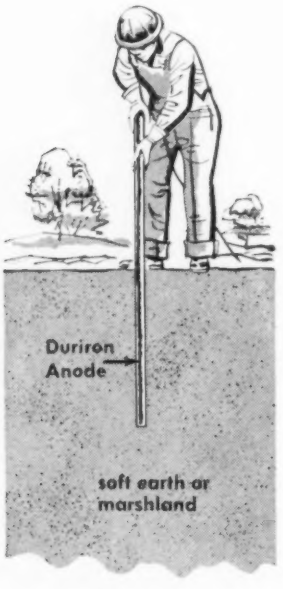
32 DURIRON® ANODES protect 11,000 feet of steel water line without backfill

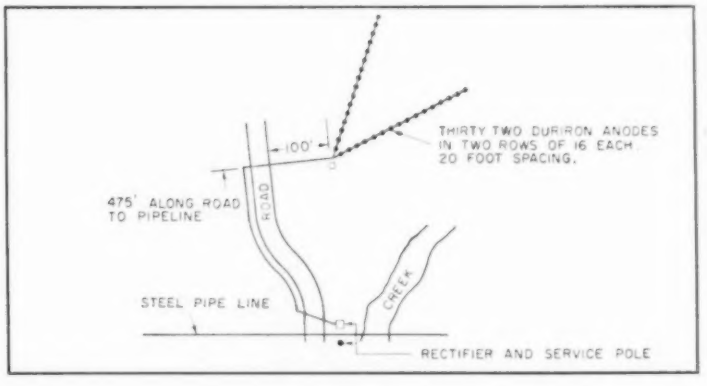
The Problem:

An isolated section of 11,000 feet of steel water line needed cathodic protection. Tests showed current requirements to be 40 amps., but replacement of adjacent wood stave lines called for extra capacity. Ground was a peat bog with water table standing at 6 inches below surface, making backfill methods impossible.

The Installation:

32 Duriron Anodes (2" x 60") were installed without backfill, by digging through the dry surface and then pushing anodes down until the tops were 3 feet below surface. Anodes were installed 20 feet apart, in two rows, with a calculated resistance of one ohm, based on previous experience with similar installations. While conventional backfill columns would have reduced the number of anodes necessary, the use of bare anodes constituted a major saving in cost.




100'
THIRTY TWO DURIRON ANODES IN TWO ROWS OF 16 EACH 20 FOOT SPACING.
475' ALONG ROAD TO PIPELINE
ROAD
STEEL PIPE LINE
CREEK
RECTIFIER AND SERVICE POLE

The Performance:

The anode bed is discharging 60 amps. at a terminal voltage of 59 volts. The entire line section is under protection, the minimum potential being 1.18 volts. This affords ample margin to handle prospective additions to the line. Agreement between actual and calculated anode resistance is quite close.

Action:

For further information on this particular installation or for technical assistance on other Duriron impressed current anode installations, write:

DURCO
CORROSION RESISTING ALLOYS & EQUIPMENT

THE DURIRON COMPANY, INC. / DAYTON, OHIO

PIPE LINE PANORAMA

Offshore Logjam Due to Break Wide Open . . . Long awaited expansion for Louisiana Offshore pipe line projects is slated to kick off soon:

- 119 miles of 6-20 inch line for Transco in Eugene Island and Ship Shoal areas—most of which is offshore.
- 35 miles of 16-inch and 26 miles of 10-inch for Transco in the West Cameron and High Island areas.
- 22.5 miles of 16-inch gas-condensate line for Magnolia to West Cameron, Block 110, to be laid by Brown & Root. Brown & Root now is completing gas gathering network for TGT in East and West Cameron areas.
- 28 miles of 30-inch line for Tennessee Gas in Lake Borgne area—contractor, Sharman, Allen, Gay and Taylor—plus 38 miles of 30-inch bay and marsh work east of Mississippi River to point onshore near Louisiana-Mississippi state line—Houston Contracting Company. TGT's over-all project includes 556 miles of 30-inch line.

West Texas Producers to Get Well Connections . . . With the exception of a few early affirmative statements, independent producers are reserving opinions on result of their 17-month campaign to connect 8,000 West Texas wells. Generally termed Railroad Commission order of June 4 says common carriers must connect lease batteries upon application by producer to carrier.

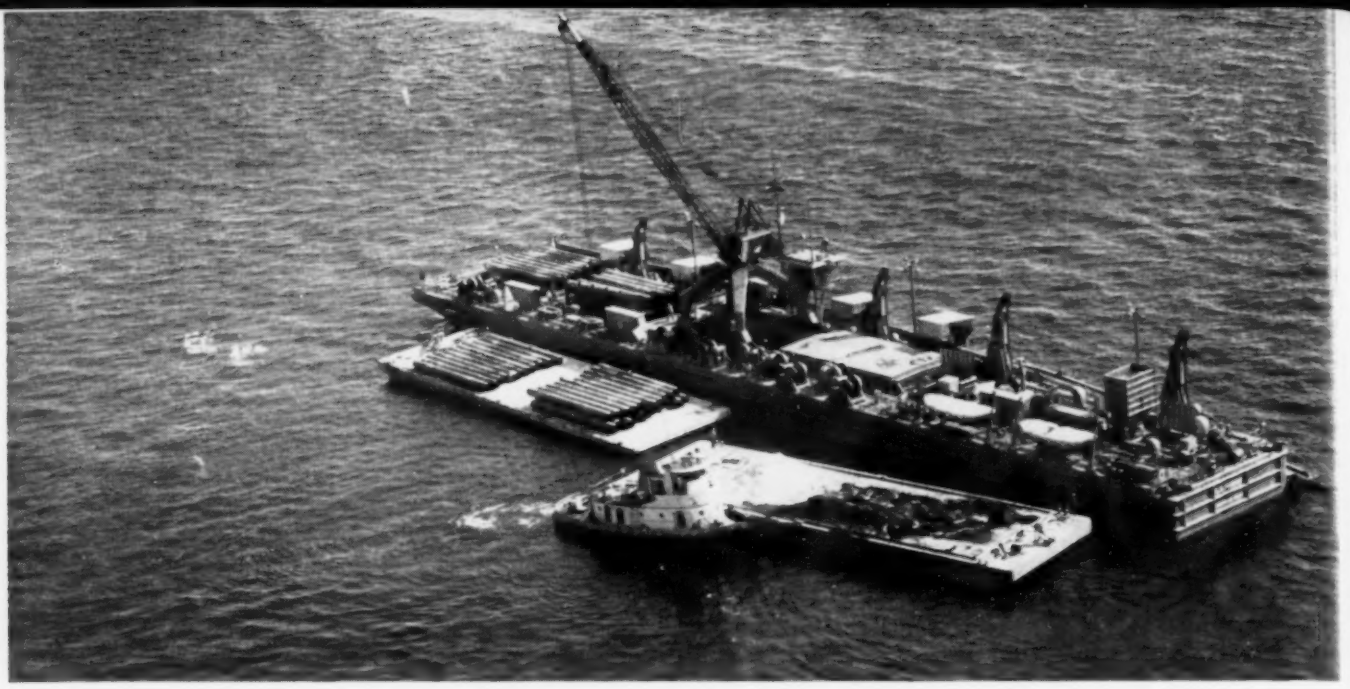
Ruling covers fields or reservoirs where only one pipe line is operating and within general area served by common carrier that is affiliate or subsidiary of common purchaser. Although carriers must justify failure to make connections, they may seek exceptions to rules set out.

Quicker Check of Pipe Line Welds with New Isotope Pellets . . . Aramco engineers are inspecting pipe line welding defects with a more powerful type of gamma ray radiography unit. They say new unit, which uses ½-inch long pellet of iridium-192 as energy source, is 10 times more powerful than conventional equipment. Technicians take 15 to 20 pictures per day with no loss of quality, and can send gamma rays through thicker sections of metal. Weaker iridium pellets now in use allow only three exposures per day.

Little Big Inch Carrying LPG . . . Texas Eastern's Little Big Inch started carrying liquefied petroleum gas on July 1—the first time a common carrier has offered such service. Transportation charges: 54 cents per barrel to ship from Beaumont, Texas to Ohio terminal—56 cents from Baytown, Texas.

Washington Panorama . . . Predictions are that Alexandria, Va., price-fixing trial of 29 oil companies may not get underway until '59, then will drag out for many months (See Editorial, Page 4) . . . **Look for more antitrust investigations** of nearly every segment of the industry . . . **IPAA predicts natural gas producers** will be freed from utility-type controls next year; reason: most powerful enemy of Harris Bill, the coal industry, has come to terms with transmission companies.

Gas Utilities and Pipe Lines Set Safety Record . . . American Gas Association reports that industry's accident frequency rate in '57 was 8.55 per million man-hours worked. Severity rate: 447 days lost per million man-hours. Previous record, set in '56: Frequency rate of 8.68 and severity rate of 652. Report is based on 434 companies representing more than 95 percent of industry's 205,000 employes.



The L. E. Minor, Brown and Root's newest pipelaying barge, completes 20 and 26-inch gathering lines in TGT system off Cameron, La. Innovations in hull design, line-up and welding, plus more positive pipe string control promise faster submarine pipelaying.

Barge Minor Makes 214 Joints a Day

Brown and Root's latest addition to offshore pipelaying fleet has automatic pipe handling workway. Heavy-duty davits and modified "stinger" astern control string positively during laying, lowering or raising.

By Melvin A. Judah, Editor,
PIPE LINE INDUSTRY

NOT ALL the answers to the tough problems of submarine pipelining have been found yet. So far no one has come up with a way to control the wily Gulf weather. Offshore pipeliners try to predict it, equip a barge to live and work under anticipated conditions and still lay pipe at a reasonable cost. It is a method that requires both money and plenty of hard work to make progress.

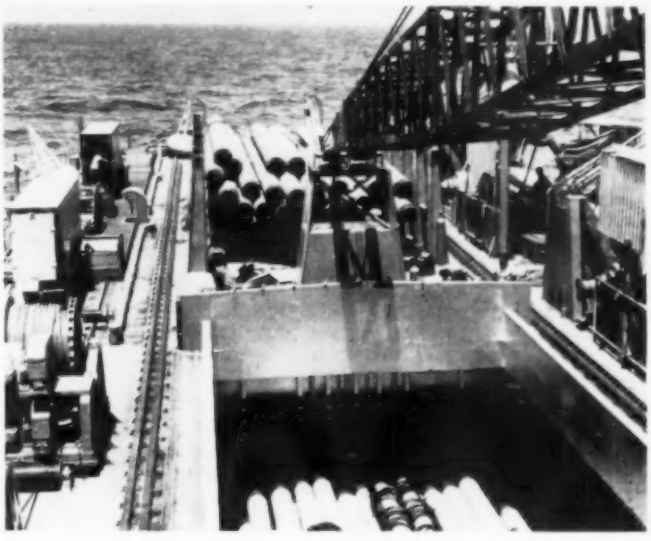
Automatic pipe stalking rack speeds line-up and stringer bead welding; an electric powered conveyor moves joints along rail to hydraulically positioned, V-shaped, rubber roller dollies. Pipe supply is maintained by traveling gantry crane, there is no sideboom on deck.

Brown and Root's new $2,350,000 barge, the L. E. Minor, is designed and equipped to handle most of the tough conditions met. Several important new features enable it to speed up pipelaying, control the completed pipe string positively and ride out weather conditions so that it may keep working when other barges have to be moved in to sheltered water.

An automatic stalking station reduces handling of pipe joints to a minimum. Two pipe storage racks provide a readily available deck supply of pipe; the forward rack has an electric powered conveyor system which automatically feeds pipe to the line-up rollers on the pipe workway

There are five covered welding stations on the inclined pipe launching ramp. The fifth station may be used either for X-ray inspection, as is being done now, or as an extra filler pass station on heavy wall pipe.

Joint on dollies may be raised, lowered, tilted or rolled by power equipment; there is no unnecessary hammering on pipe. Sections of rail conveyor on left can be folded up and in to permit gantry crane to move full length of barge.

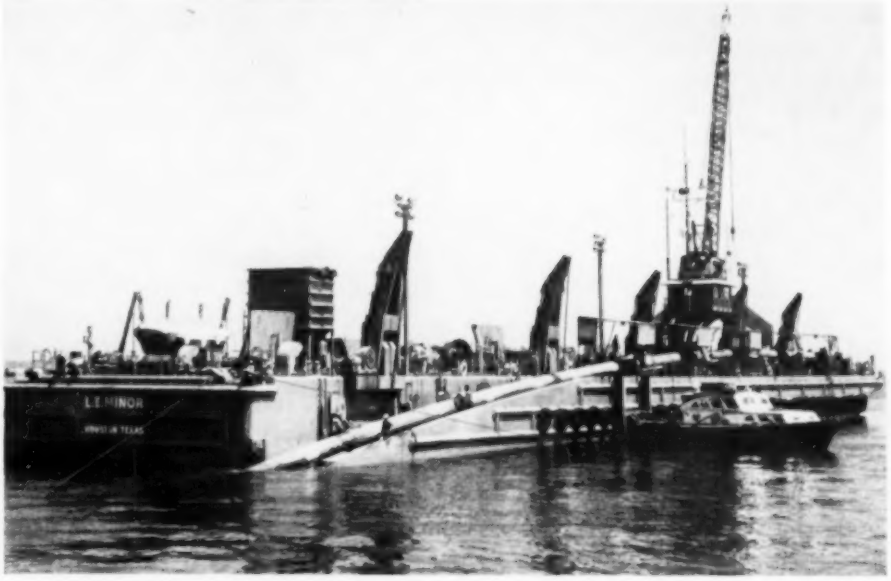


(Right) Two holds, plus a pipe storage rack on forward deck, keep a pipe supply readily available to the automatic stalking rack. Rails and drive rack for the gantry crane permit it to work the full length of the Minor; the crane also handles supplies from barges alongside, rigs stinger, sets risers and handles other chores over the side.

and eliminates the need for sideboom tractors on deck. Sections of the conveyor rack fold upward and inboard to permit a gantry crane to move the full length of the barge. Additional pipe storage is provided below deck in two holds and on barges moored alongside in good weather.

Over-all, the Minor is 350 feet long, 60 feet wide and 22½ feet deep; its gross tonnage is 3,475 tons. Maximum allowable draft is 12 feet, however it normally draws only 10 feet when laying pipe with the 320-foot pipe supporting stinger astern. Design was in accordance with American Bureau of Shipping Regulations and Coast Guard rules. The barge was named for Brown and Root's vice president for pipe lines.

The first pipelaying job for the Minor has been completion of 4.5 miles of 26-inch and 10.4 miles of 20-



The inclined workway and floating stinger astern gives completed string a long radius over bend as it trails to the bottom in the 50 foot deep Gulf waters. Five hydraulically positioned davits, equipped with anchor chain falls facilitate lowering the pipe string if it becomes necessary to get out from under the pipe during storms or heavy seas. Chain falls are left on the pipe and secured to marker buoys to speed up recovery of the string when work can be resumed.

The 320-foot "stinger" shown being towed into position for rigging, gives vertical support to the completed pipe string astern of the Minor. Its 30-inch legs are subdivided into eight sections; flooding of each section is controlled separately to meet the buoyancy requirements of the particular diameter and weight of pipe string supported.

Flotation stinger alongside the Minor is ready to "receive" previously completed pipe string lifted off the bottom by the davits. After the pipe string is set into the dollies the barge moves ahead; the yoke and the pinion of the flotation unit can then be secured to the frame at the end of the pipe workway.

inch in a gathering system for Tennessee Gas Transmission Company off Cameron, La. The best day's progress for the Minor was chalked up on the 20-inch line between TGT's gathering platform 49 and 192 when 214 joints were laid in two 12-hour shifts. Brown and Root's barge the M-211, and other units had completed much of the network last year.

Quicker Line-Up. A hydraulically powered stalking machine moves joints of pipe into position at the forward end of the pipe laying ramp; line up is made by lifting, tilting or rolling the joint as necessary by the powered rollers and cradle. Two roller cradles can be raised or lowered by separately controlled hydraulic hoists. All pipe is taken aboard, stowed below decks in holds, or supplied to the forward storage racks by the rail mounted gantry crane.

Gantry Crane Covers Deck, Alongside Work, Too. The 120-foot boom crane travels on a specially designed traveling gantry. Twenty bearing wheels carry it along rails and drive gear rack the full length of the barge. Rail span is 28 feet center to center.

Crane boom coverage not only extends over the full length of the barge; it can also work the side for handling pipe and supplies from barges, lifting and lowering the pipe string or stinger when necessary; setting risers or small platforms, and handling other chores such as driving piling.

Ships Power Rectified for Welding. Three 400-ampere DC rectifier units operate on ships power supplied to each of the five welding stations on the pipe workway. Rectifier units for the last station are installed below decks; only the amperage controls are located at the final station on the welding ramp. Below deck installation of welding units has proven so satisfactory that all units will be put below deck when barge is modified this winter. The only moving part in the rectifier units is a blower for forced draft cooling.

The fifth station is normally used for X-ray inspection, however, a temporary X-ray station may be set up further aft when this station is used for welding on heavy wall pipe. Weld inspection on the Minor is now subcontracted to Industrial X-Ray Engineers.

Davits Lower or Raise Pipe String. A major problem in submarine pipelaying has been safe lowering of the completed string to the bottom in case rough weather forces a lay barge in to shelter, then lifting it up to resume work later. Five heavy-duty davits, spaced at 60-foot intervals on the starboard side of the Minor just inboard of the pipe launchway, lift the completed string out of the launchway and then swing out and lower it over the side of the ramp to the bottom.

Anchor chain falls for the davits are left attached to the pipe when lowering is completed; buoys are secured to the top end of the chain to mark pipe location and speed lifting for resuming work. It is not necessary to send a diver down to rig cables or chains to lift the pipe. These

All eight of the barge Minor's anchors are controlled from this console located in a tower directly above the pipe launchway at the middle of the barge. Anchor winches are controlled individually with the two speeds in cable "take-in" or "run-out." Operator can sight down pipe string to marker buoys along right-of-way.

Tugs handle the 10,000 pound anchors by which the Minor kedges along the pipe line route. Cable pendant from anchors are secured to steel buoys which have a heavy welded steel cage on top for towing purposes. Chalking white paint on buoys makes them readily visible for checking anchor position in foul weather or by spotlight at night.

davits used in conjunction with the gantry crane eliminate the need for an extra derrick barge for many submarine pipelaying tasks. For example, together they can raise the pipe string and rig the flotation stinger astern of the barge when resuming work on a pipelaying job.

Stinger Supports String Astern. Concrete coating as well as the elastic limit of the steel pipe requires that the pipe string be given some vertical support as it is lowered to the bottom in Gulf waters 50 to 90 feet deep. Modifications to the basic twin flotation cradle, or "stinger," developed by Brown and Root last year (See PIPE LINE INDUSTRY, October, 1957, Page 43) were built into the new model used with the Minor.

Two 320-foot long flotation legs are subdivided providing eight separate flotation cells in each. Valving permits partial or complete flooding of cells to give the completed string the proper overbend as it enters the water. Rubber roller cradles fabricated between the flotation legs support the pipe string; a heavy steel yoke and pinion at the leading end of the stinger attach it to the after section of the launchway.

Spoon Bow Reduces Spray. Movement of the Minor is normally by kedging along on one or more of its eight 10,000 pound Navy type stockless anchors so there isn't any need for having a streamlined hull. Designers put a spoon shape bow on the barge to cut down on the amount of spray blown up on deck when seas kick up from ahead in an effort to maintain dry working areas at the line-up and first two welding stations.

With winds and seas from astern, the Minor's crew believe it can lay pipe in 8 to 10 foot seas; however, if winds and seas are more abeam, work might have to be shut down somewhat sooner.

Anchor Control. To work the eight anchors, each has 3,000 feet of 1½-inch steel cable threaded from its winch through fairleads on deck and on the corners of the barge. Each anchor winch is powered by two 50-hp DC electric motors. Winches may be operated individually at two speeds to take-in or run-out anchor cable. In this manner the barge is controlled positively at all times when anchors are holding on the bottom.

A glass panelled anchor control tower near the mid-point of the barge is about 20 feet above the center of the pipe launchway. Operators can sight directly down the pipe string to the buoy markers and keep on line, controlling the barge precisely from the anchor console nearby.

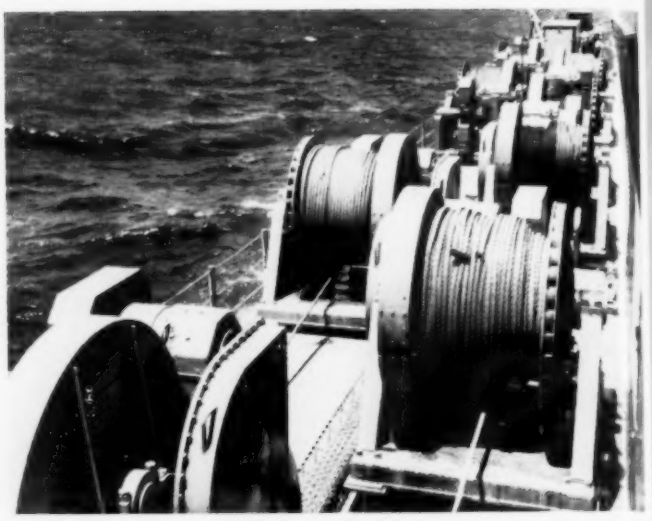
Specially fabricated anchor buoys have a heavy welded steel "cage" on top for securing lines from the towing tug. They are painted a chalking white for ease in sighting from the barge, tug or passing vessels.

Below Deck Engineering Spaces. All of the machinery that could possibly be located below decks on the Minor was put there to provide a clear working space on deck and to protect it from the weather.

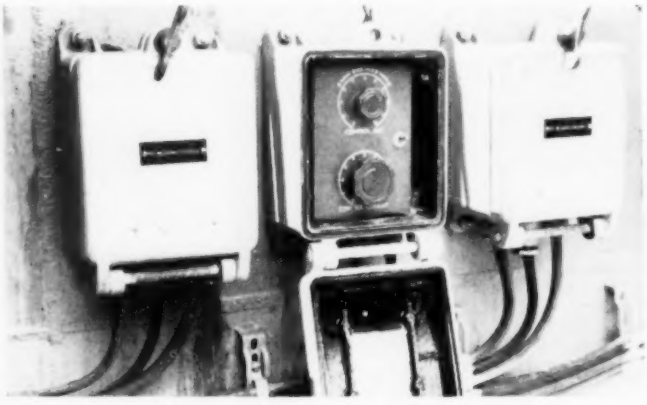
The three main generators for ships power are driven by 505 horsepower, turbocharged diesel engines. Number one generator is a 350 kw AC, while numbers 2 and 3 have, in addition, a 250 kw DC generator coupled through the AC unit with a flexible coupling. Also located in the engine room are the compressors supplying air operated tools and starting air for engines; a steam plant for pile driving equipment, generator control panels, workshop spaces, fresh water pumps, flushing water and bilge pumps and spare parts storage. An auxiliary engine room in the forward below deck spaces houses all of the air conditioning equipment.

Pipe protection equipment including heating kettle, concrete mixer and coating and wrapping supplies for protecting field joints are located just below deck on the starboard side

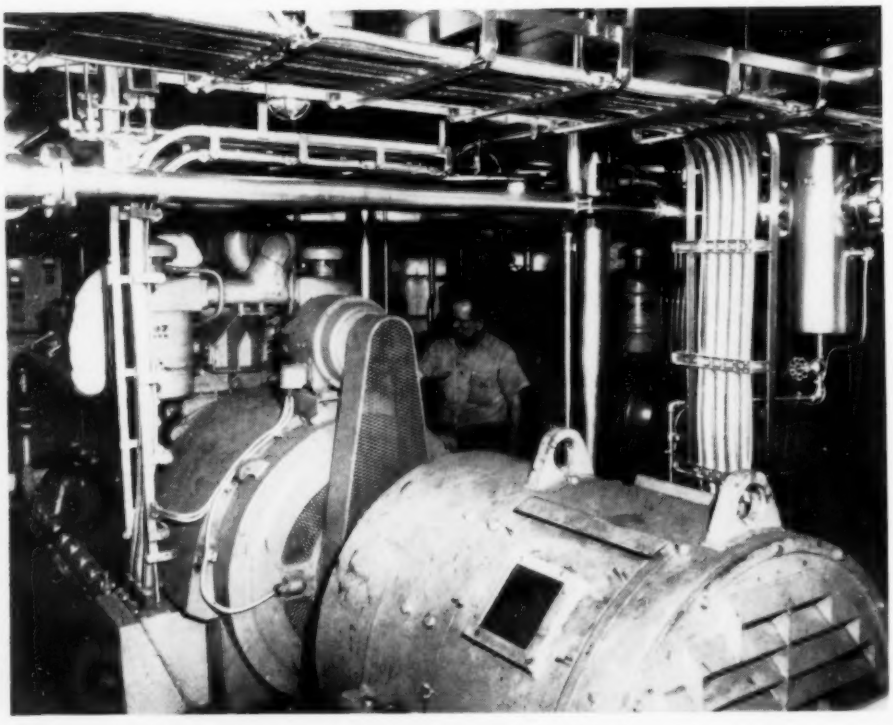
Three 400-ampere DC rectifier units utilize ships AC power to supply each of the five welding stations. Rectifier units are air-cooled by individual blowers. Sheet metal panels deflect spray.



Each anchor winch is powered by two 50-horsepower electric motors for two speed operation. Cable reels have 3,000 feet of 1½-inch steel cable; fairleads are located on cable deck runs below grating and at corner of barge.



Rectifier units for the fifth welding station are below deck; only the controls are located at the workway station.



Electric power is supplied by three 505-horsepower diesel engine driven generator units. Each generator is a 350-kw AC unit; in addition the two units shown here have a 250-kw DC generator coupled through the AC unit for anchor winch power supply.

of the barge near the stern. Coating and concrete are supplied through doors to the work stations on the launching ramp.

2000 Meals a Week. The Minor has air conditioned quarters for 88 men including a dining room, galley, four-bunk staterooms, lounge and recreation room with television, radio and reading material. In Navy lingo, the Minor is not only a "worker" it is also a "feeder." During the first five weeks the barge went to work in the Gulf, cooks averaged serving 2,000 meals a week. Because of the work schedule of the two 12-hour shifts, four meals are served every day on the Minor.

A full time laundryman makes use of the complete laundry facilities to do all of the laundry for the crew and also for any other barges in Brown and Root's pipelaying fleet in the area.

In addition to the welders, helpers, swampers, dopemen and pipeliners that work on the pipelaying ramp, the barge crew includes two engineers, two oilers and one electrician in the engineering force; two cooks and four helpers in the galley, two room orderlies, plus two deck hands that handle maintenance and painting.

The barge's topside crew consists of the captain, an anchor foreman and four anchor operators, two crane operators and two riggers, a radioman, office manager, timekeeper and two time-checkers. Additional living facilities are also provided for company inspectors, X-ray technicians, divers and any other sub-contractor and specialist personnel aboard. —**The End**

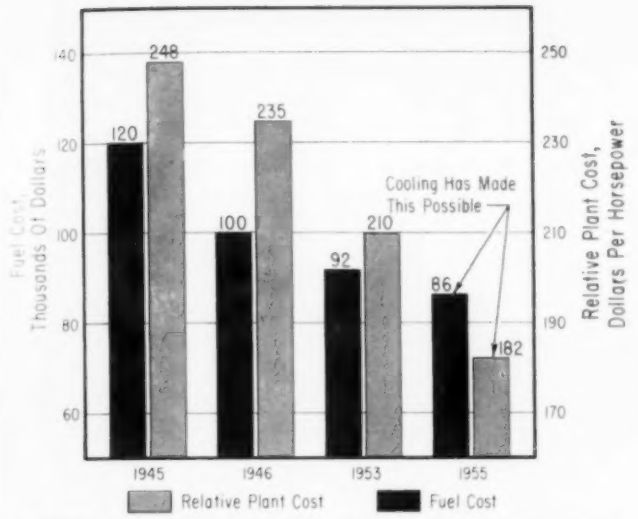


FIGURE 1—In the last 10 years improvements in engine design have made it possible to install compressor stations with higher horsepower at reduced costs per horsepower, and with lower annual fuel costs. A 10,000 hp station today costs $66 less per horsepower than if it were powered with a 1947 model engine and at the same time has a $33,500 lower annual fuel bill. Today's engines use only 60 to 70 percent of the fuel to produce a horsepower-hour as it required only 12 years ago.

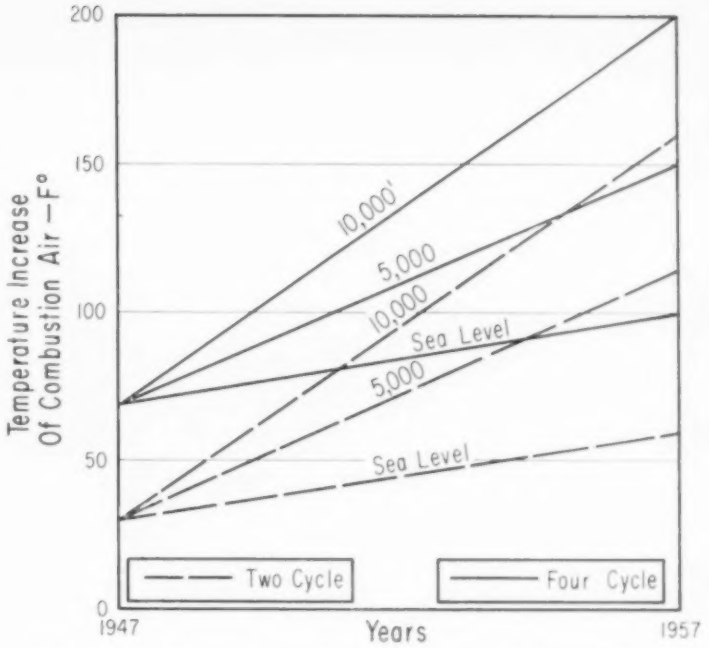


FIGURE 2—Temperature of combustion air before cooling has steadily increased since 1947. Increases range from 30° F. to 160° F. for two cycle engines and 70° F. to 200° F. for four cycle engines.

Combustion Air Conditioning— a Step Forward in Engine Design

Today's compressor stations get more horespower at reduced installation costs per horsepower and lower annual fuel costs.

By W. R. Crooks,
The Cooper-Bessemer Corporation, Mount Vernon, Ohio

In the last 10 years power requirements in gas transmission systems have been increasing. In fact, just since the advent of the 30-inch transmission line and use of higher operating pressures, they have almost doubled. Lower compression ratios across compressor stations and closer spacing of stations have made larger compressor units feasible.

Specific output of engines has increased by 40 to 60 percent during the past 12 years. Three important developments are primarily responsible for this increase.

- Development of gas engines having high compression. Before 1947 pressures were in the 80 to 135 psig range; present engines have been in the 250 psi range for two cycle engines and up to 600 psi for four cycle supercharged engines at rated load.
- Turbocharging gas engines has increased the specific output by 30 to 100 percent.
- Cooling of combustion air has increased the specific output and given better fuel consumption.

Lower Cost Per Horsepower. Today's trend toward greater power requirements has been accomplished with a lowering of cost per installed horsepower. A 10,000-hp compressor station using a medium size engine costs $66 less per horsepower using today's engine than if it were powered with a 1947 model. A comparison of the relative cost of such a station over the last 10 years is illustrated in Figure 1.

Increased distances from the gas field to market and rising costs of field gas have made fuel costs more significant. Figure 1 compares the annual fuel cost per horsepower-hour as the size and specific outputs of engines have increased. The same engines that reduced the capital costs $66 per horsepower also have a $33,500 lower annual fuel cost. Engines of the latest designs use only 60 to 70 percent of the fuel to produce a horsepower-hour as was required only 12 years ago.

Combustion Cooling Necessary. Temperature of the combustion air has increased with the increase in specific output. High specific output engines all have the cylinders pressure charged by mechanically driven compressors, turbochargers or a combination of both. Combustion air temperature increases range from 30° F. to 200° F. as shown in Figure 2.

If only combustion air density was affected by higher air temperatures, charging the cylinder to a higher pressure level would provide compensation. The cost of the increased com-

Combustion Air Cooling System

Evaporative Cooler in the Induction System

Maximum temperature drop of 25° F. from highest temperature. Not too effective in a pressure-charged engine since heat of compression raises air temperature from 50 to 175° F.

Aftercooler Between Pressure Charger and Engine

Aftercooler cooled by water from:

- **A radiator—cools combustion air to ambient plus 35° F.**
- **Evaporative cooler supplying water to aftercooler—under maximum temperature conditions cools combustion air to ambient minus 5° F.**

Precooler—Aftercooler Combination

Under high ambient conditions normally cools combustion air to ambient temperature. Relatively simple system with the precooler in induction system. Aftercooler located between pressure charger and engine cylinders. Precooler cools and humidifies air, and in the process, provides cool water for the aftercooler. Water returns and is sprayed into top of precooler.

Chill Cooler

Cools combustion air to approximately ambient minus 15° F. under high ambient condition such as 75 wet bulb, 100 dry bulb. A modification of an evaporative cooler located between compressor and engine. Water cools by direct water contact. Heat is dissipated by an atmospheric evaporative cooler.

Turbocooler

Cools to 50° below ambient if evaporative cooler is used to supply water to the turbo-aftercooler; 50° below ambient if external radiator cools turboaftercooler. Turbocooler is an extremely simple air refrigerating system. Portion of heat of compression from the turbocharger and turbocooler are carried away by a conventional aftercooler. Energy for refrigeration is provided by turbocharger, which delivers air at a higher pressure than necessary for combustion. Energy obtained from expander wheel drives a compressor, and air in doing work when passing through expander wheel reduces the temperature by approximately 40° F. Where an external radiator is used to cool the aftercooler water during below freezing weather, and an evaporative cooler is used in the summertime, optimum performance is obtained through the year.

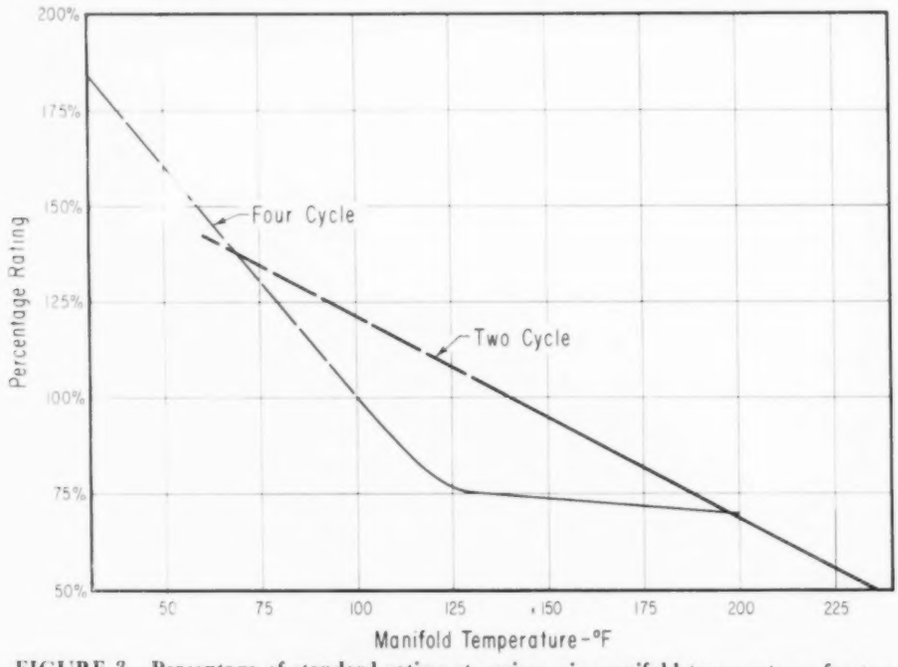


FIGURE 3—Percentage of standard rating at various air manifold temperatures for two cycle engines operated to maintain 680° F. constant exhaust temperature, and four cycle supercharged gas engine rated to give combustion characteristics obtained at full load with 100° F. manifold temperature, and 62.5 Btu hp-hr. fuel consumption.

pression could be balanced against the cost of cooling. However, constant air density is not the entire answer. There seems to be a critical combustion air temperature above which the engine will detonate at rated load regardless of the fuel-air ratio. When this critical condition is reached in any given engine, with a given fuel, load level and air temperature, the load must be reduced or the air must be cooled to prevent detonation. Reducing the load will permit higher temperature before detonation. More density, or pounds of the same temperature air will not stop the detonation.

Tests Determine Critical Temperatures. At higher combustion air temperature the detonating load limit will be decreased approximately 3½ percent for each 10° F. increase in air temperature for both two and four cycle engines. Four cycle turbocharged engines deviate from this uniformity in detonation limit at about 130° F.; a 10° F. decrease in combustion air temperature between 100° F.; and 60° F., raises the detonation load limit by roughly 10 percent.

In Figure 3 the manifold air temperature is plotted against percentage rating illustrating the results of these tests. Cooling of combustion air is a necessity for gas engines operating above 82 bmep on two cycle engines or above 115 bmep on four cycle engines.

Fuel Consumption Improved. Cooler combustion air inproves fuel consumption in at least three ways in engines with high specific output.

1. Permits higher specific rating by raising the detonation load limit with almost constant mechanical friction and with consequently improved mechanical efficiency. With increased loading the specific fuel consumption will decrease provided combustion efficiency is maintained.
2. Cool scavenging air flushes the hot product of combustion from the cylinder clearance. The cooler charging air removes heat from internal surfaces, lowering the heat of the cycle. Increased specific loading may be added until heat of the cycle comes up to values established by years of operation.
3. Permits higher combustion efficiency. Four cycle higher con-

pression supercharged gas engines operate on a very lean mixture. Cooler air permits a richer mixture and more efficient burning.

Engines Not Improved. Combustion air conditioning is not of equal importance in all types of engines and engine operation. The exceptions are of enough importance to warrant some clarification. Combustion air conditioning is not economically justifiable for:

- Atmospheric two and four cycle engines.
- Turbocharged higher compression four cycle engines rated below 110 bmep.
- Low compression, slow speed, long stroke turbocharged horizontal engines, rated at 90 to 110 bmep.

Under the following operating conditions combustion air conditioning is beneficial and essential to achieve the higher specific output and fuel economy now possible:

- Supercharged medium and high compression gas engines operating at above 90 bmep on two cycle engines, and 110 bmep on 4-cycle engines.
- Supercharged diesel engines, generally above 125 bmep.

Horizontal Gas Engines Special Case. Turbocharging existing hori-

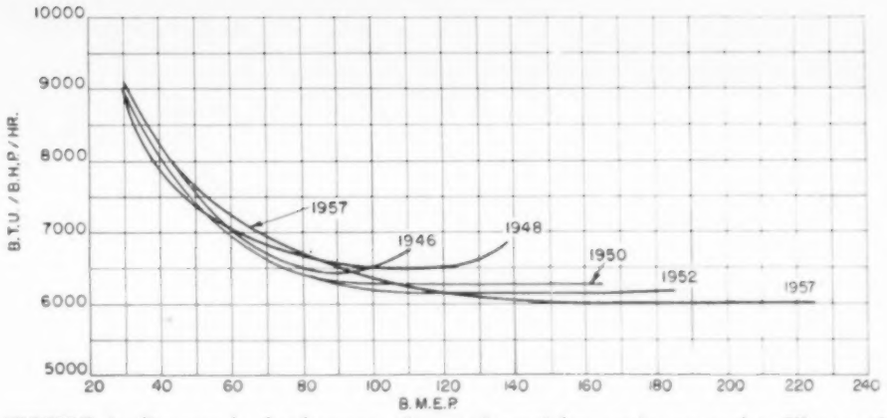


FIGURE 4—Progress in development of supercharged four-cycle gas engine. Illustrated are the fuel economy, detonation-free pulling ability in bmep, and the time in years. Combustion air conditioning was applied in 1950, increased cooling in 1952, and turbocooling in 1957.

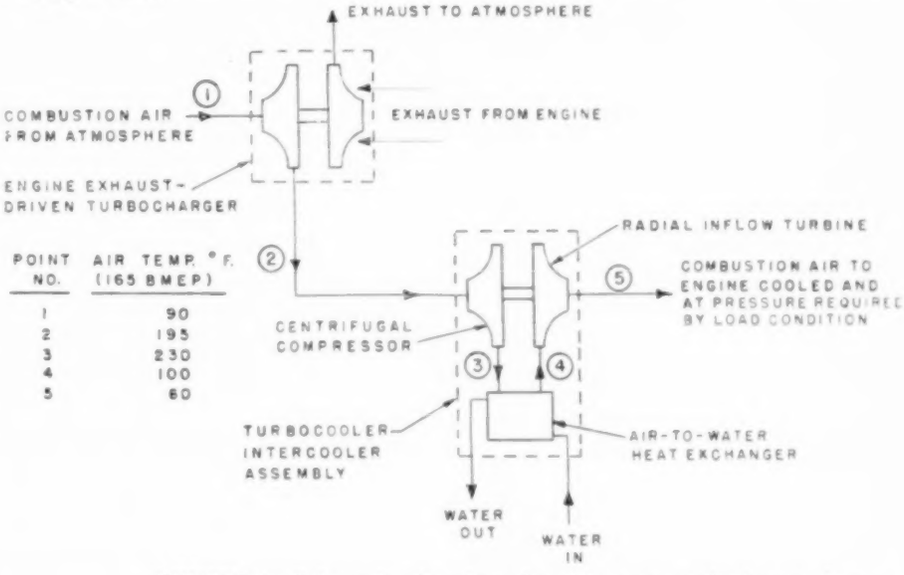


FIGURE 5—Schematic of turbocooler. Air enters turbocharger, is compressed by exhaust gas driven centrifugal blower. Pressurized air at elevated temperature is directed to booster in turbocooler for second stage compression. Air is cooled by air-to-water intercooler before entering turbo-expander. Pressure drop through expander motivates expander impeller. As air expands through impeller, temperature drops 15 to 40 degrees.

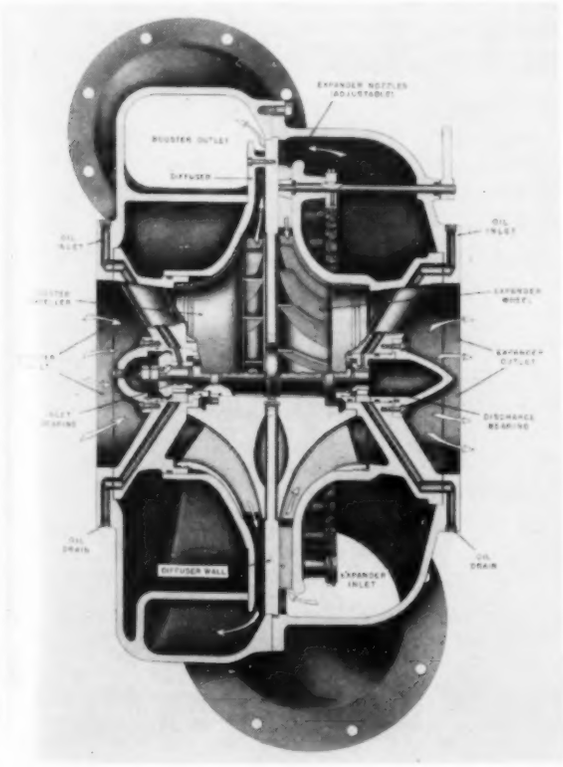


FIGURE 6 (At left)—Cross section of turbocooler charts progress of engine intake air through booster stage compression and through the expander cooler.

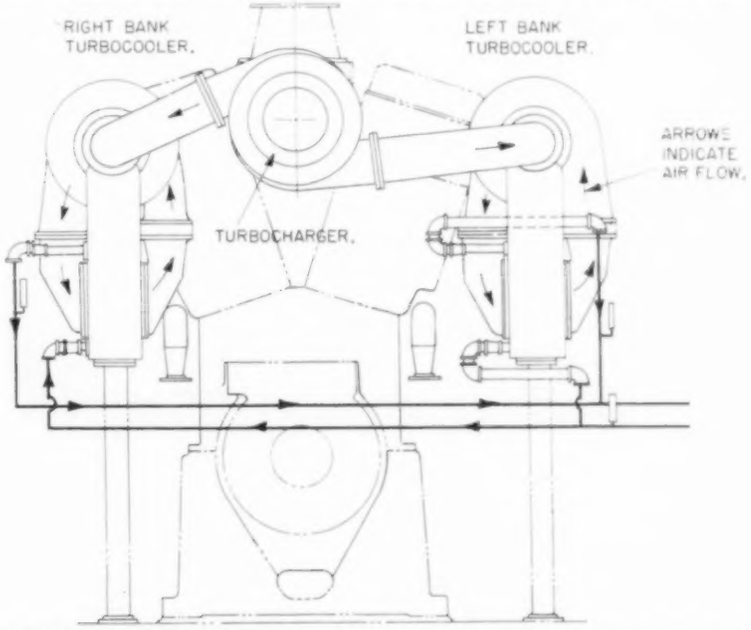


FIGURE 7 (Above)—Schematic of turbocooler mounted on four-cycle supercharged spark-ignited gas engine.

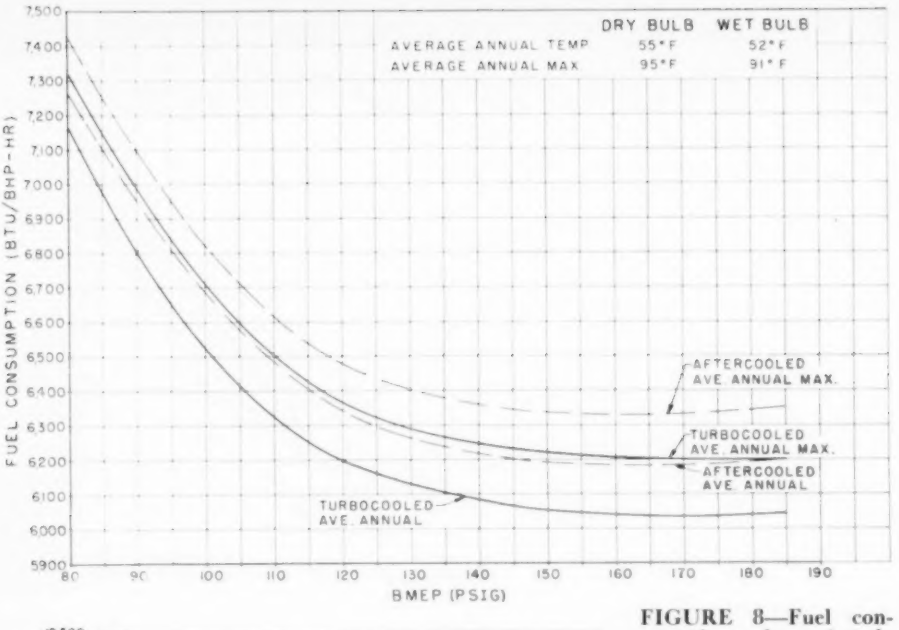


FIGURE 8—Fuel consumption of a 4-cycle spark-ignited gas engine at various loads, and using various combustion air conditioning systems. Engine was run at 327 RPM. Added economy resulting from turbocooling as compared to conventional aftercooling is evident.

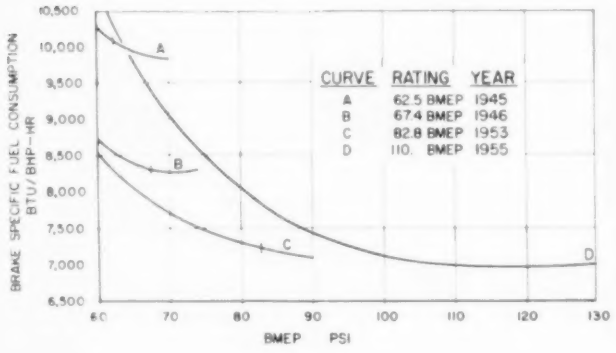


FIGURE 9—Evolution of the 14 by 14 two-cycle gas engine over a 10-year period.

zontal gas engines has increased the horsepower 40 percent. Theoretically combustion air conditioning should be beneficial in keeping the internal cylinder surfaces from overheating when approximately 35 percent more fuel is burned in the cylinder due to increased load. This has not been the case; nor did the cylinders overheat. Tests to determine why anticipated results were not obtained showed that:

- Compression temperatures at the beginning of combustion are relatively low; maximum temperature does not exceed 500° F., which is below the critical air temperature. Higher compression ratio engines, when the air is cooled the maximum amount, have compression temperatures of 625° F.
- Lower compression ratios of 4.5 to 1 in the horizontal engines are less sensitive to detonation than present 11.5 to 1 ratio engines.
- The lean mixture, plus extra air for scavenging the clearance volume keeps the exhaust temperatures lower than originally expected. When the oxygen content was around 8 to 9 percent a 40 percent increase in load was carried with individual cylinder exhaust temperatures of 915° F.

Scavenging of the clearance volume in long stroke horizontal engines is more thorough at higher combustion air temperatures, since the higher cylinder charging pressure provides more energy in the system for scavenging. Temperature of the charge is the same whether thoroughly scavenged by hotter air, or less thoroughly with cooler. Figure 16 gives the charging pressure required for optimum combustion characteristics at different combustion air temperatures. Calculations show that the density stayed constant in the cylinder throughout the entire change in ambient temperature.

Automatic Control of Fuel-Air Ratio. Engine controls provide completely automatic control of the fuel-air ratio to give good combustion characteristics at all speeds, ambient

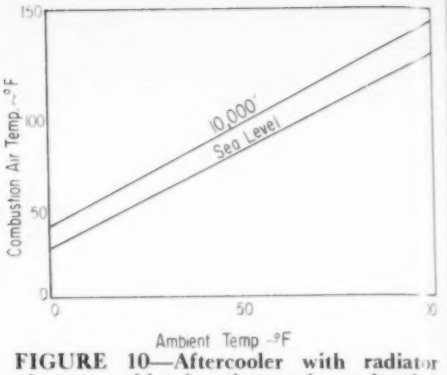


FIGURE 10—Aftercooler with radiator gives a combination that cools combustion air to ambient plus 35° F.

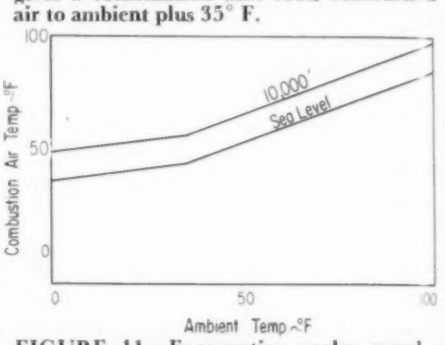


FIGURE 11—Evaporative cooler supplying water to aftercooler under maximum temperature conditions cools combustion air to ambient minus 5° F.

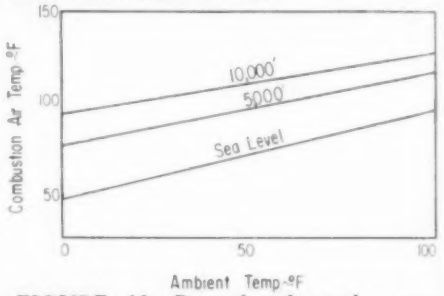


FIGURE 12—Precooler-aftercooler combination under high ambient conditions normally cools the combustion air to ambient temperature.

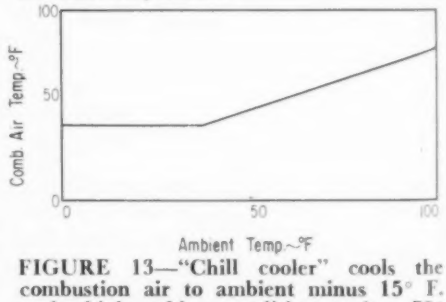


FIGURE 13—"Chill cooler" cools the combustion air to ambient minus 15° F. under high ambient conditions such as 75° F. wet bulb and 100° F. dry bulb.

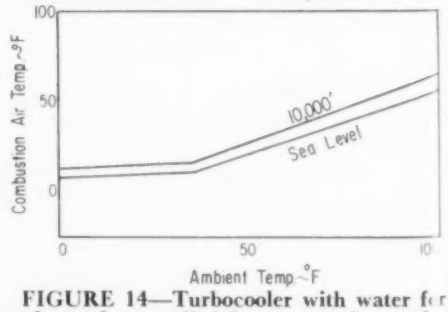


FIGURE 14—Turbocooler with water for aftercooler supplied by evaporative cooler cools combustion air to 50° F. below ambient temperature.

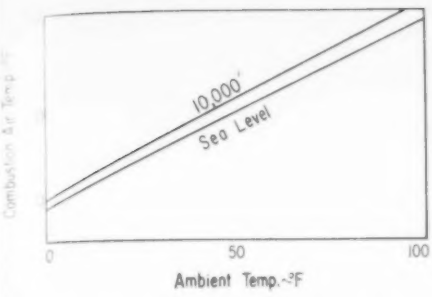


FIGURE 15—Turbocooler with aftercooler cooled with water from external radiator cools combustion air to 5° below ambient temperature.

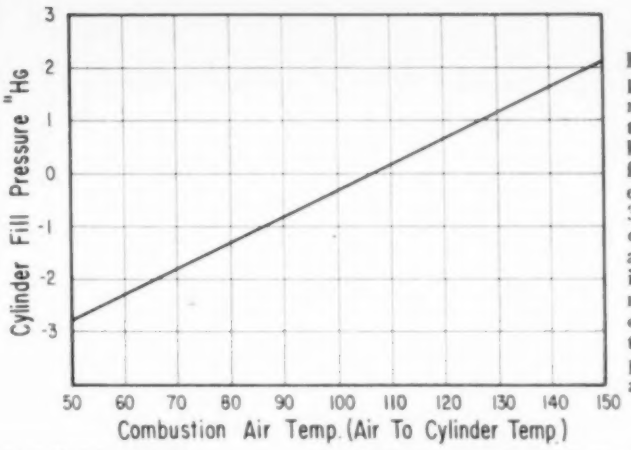
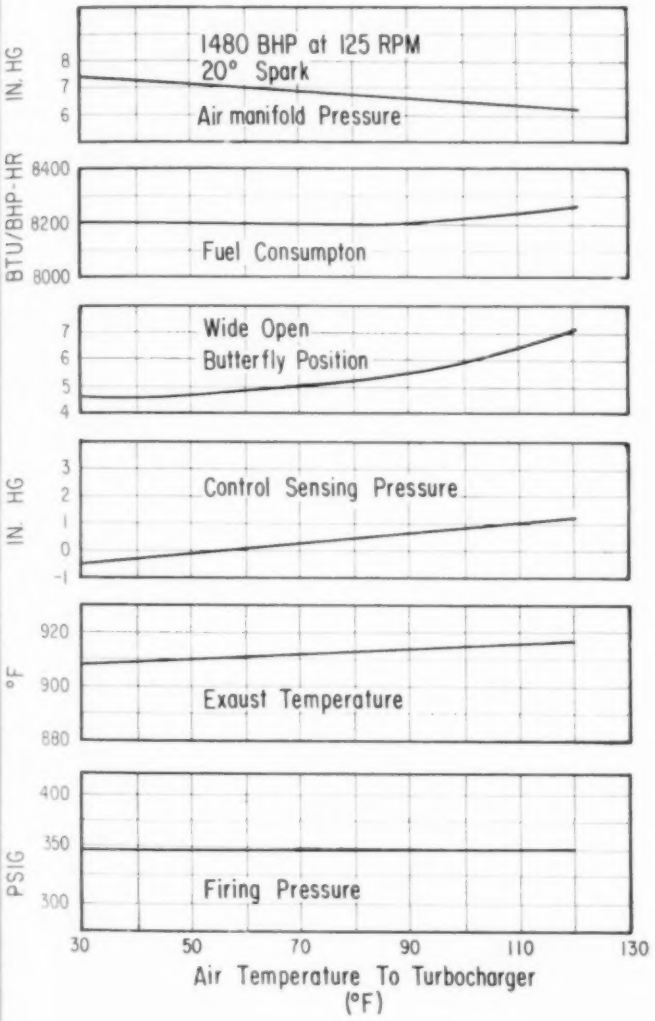


FIGURE 16—Charging pressure required for optimum combustion characteristic at different ambient temperatures for a four cycle horizontal gas engine with 21.5-inch bore, 36-inch stroke, turbocharged to 140 percent of atmospheric rating. Cylinder fill pressure automatically controlled by changes in combustion air to maintain a constant peak pressure of 350 psig at full load.



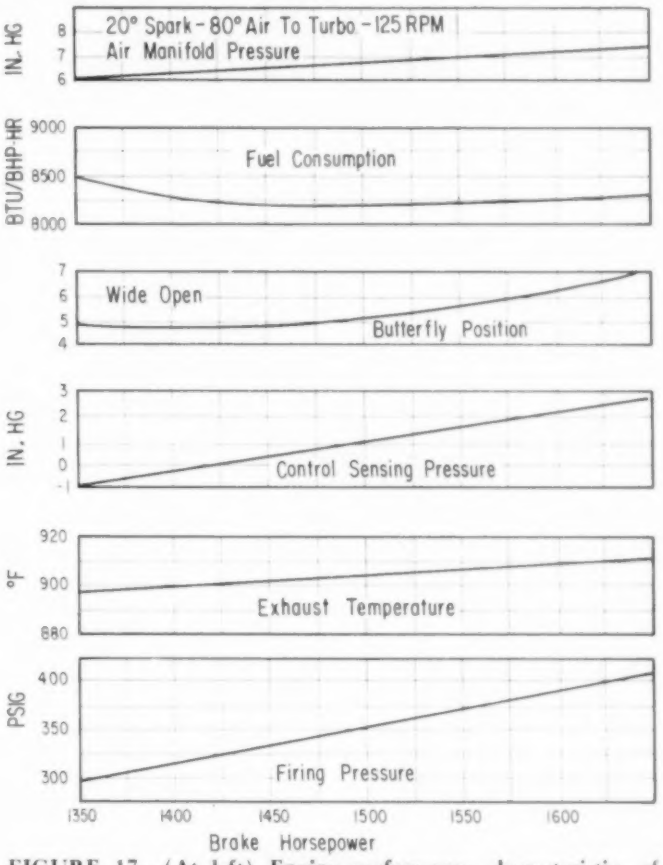


FIGURE 17—(At left) Engine performance characteristics of a four cycle horizontal gas engine with 21.5-inch bore, 36-inch stroke obtained throughout an ambient temperature range of 37° F. to 110° F. The exhaust temperature, fuel consumption, and firing pressures are practically independent of ambient temperature.

FIGURE 18—(Above) Performance of a four cycle horizontal gas engine with 21.5-inch bore, 36-inch stroke operating under variable load. Controls provide completely automatic control of fuel-air ratio to give good combustion characteristics at all speeds, ambient temperatures and loads.

temperatures and loads. Figure 17 gives the engine performance characteristics obtained throughout an ambient temperature range of 37 to 110° F. Exhaust temperature, fuel consumption and firing pressures are practically independent of ambient temperature. Performance of the same engine operating with variable load is given in Figure 18.

ACKNOWLEDGMENT

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About the Author

W. R. Crooks, chief engineer of the Development division of The Cooper-Bessemer Corporation, is a graduate mechanical engineer from the University of Missouri. Since 1923, he has been closely associated with the development, field performance and manufacturing operations of large heavy duty diesel and gas engines of both the two and four stroke cycle type. Crooks has a number of patents, one of which gives rather broad coverage on combustion air conditioning.

Strain Gages Check Stress in Bridge Piping

Engineers installed 371 elements for three-year study on Texas Illinois' dual 30-inch Mississippi River bridge. Measurements are on straight sections of bridge carrier pipe, downcomers, 75-foot hairpin approaches and angle bends to ground.

By A. G. Barkow and D. E. Clark
Texas-Illinois Natural Gas Pipeline Company, Chicago

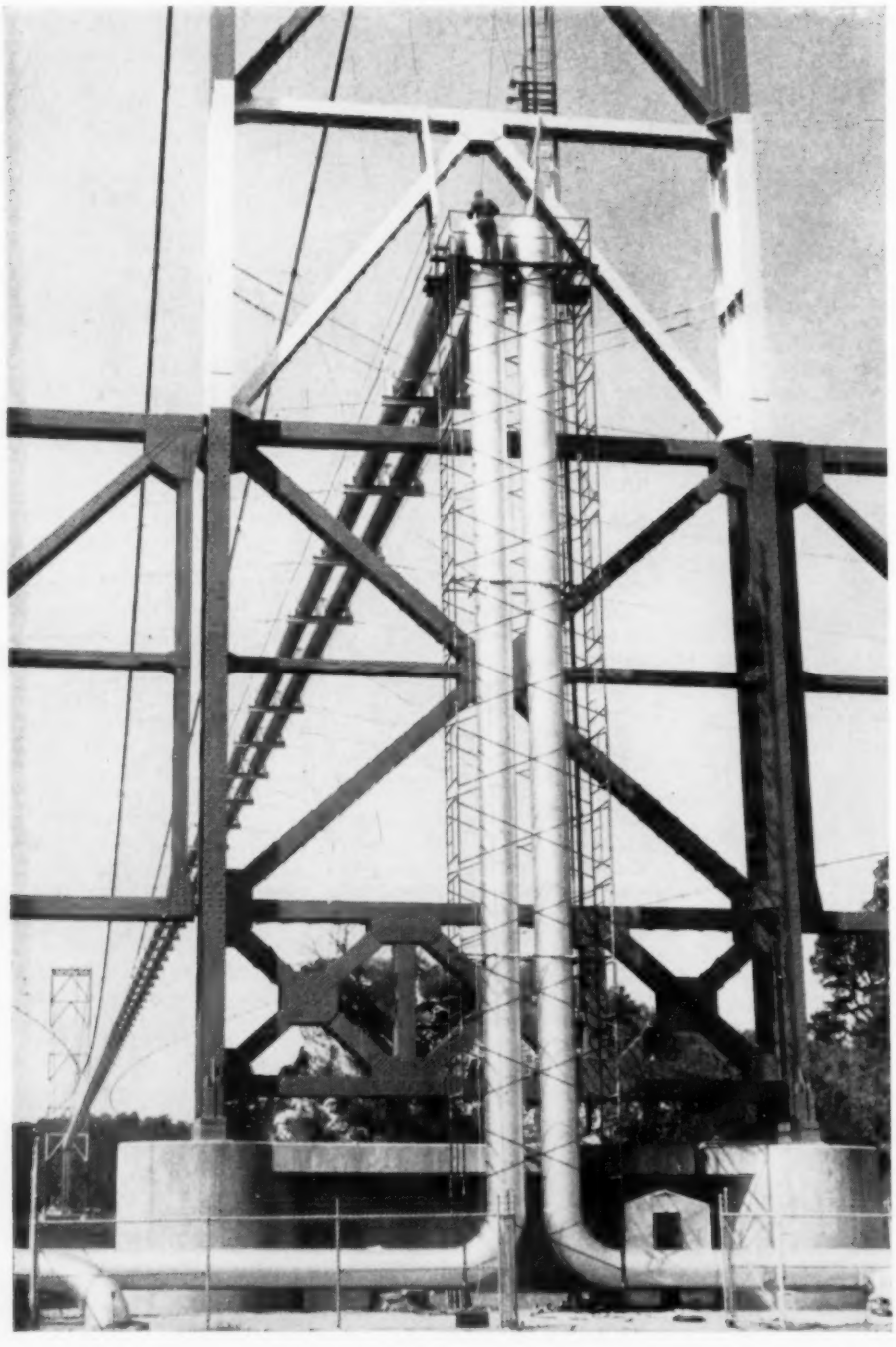


FIGURE 1—Temporary tubular scaffolding was erected to secure resistance strain gages and lead wires runs on Texas Illinois' dual 30-inch Mississippi River bridge. A total of 371 strain gage elements were fastened on the two carrier pipes to obtain a record of secondary stresses over a three-year period.

SOON AFTER completion of Texas Illinois Natural Gas Pipeline Company's half mile bridge across the Mississippi River at Grand Tower, Ill., engineers began an investigation of vibration and superimposed secondary stresses caused by forces other than internal pressure. To carry out the study, electric resistance strain gages were installed at points of possible stress on both of the dual 30-inch carrier pipe lines on the Illinois side of the river.

A great deal of engineering study is required to evaluate all of the various forces which could be acting on the twin lines and approaches to the bridge. To obtain experimental data a three-year study is being carried out to check stress calculations and provide accurate information on actual stress loads. Data is not complete enough to report on the results of the testing program, at this time however, the program planning and method of installing the strain gages are of interest.

Initially a careful study of original design data, as well as data collected on the physical movement of the bridge during the first year of operation, was made with the help of Battelle Memorial Institute. As a result of this study important potential stress areas were located; these included the last straight length of pipe on the bridge, the downcomer, a 75-foot hairpin, and the angle bend into the ground. There were two such configurations on each end, however, it was decided to check those on the Illinois side only.

Strain Gage Design. Eleven arrays of gages were planned for each loop. An array of gages consists of four rosette gages, or gage combinations

including up to two rosette gages and six pairs of single gages. Arrays were located strategically as shown in Figure 2 and wired to observe the desired information.

Single gages always were used in pairs placed at 90 degree angles from each other. Each array included two temperature compensating gages attached to the pipe adjacent to the array; one on top of the pipe and one at the bottom.

Numerous problems had to be solved in preliminary planning. Chief among these were gage installation and instrumentation of the completed set. This program used a total of 371 individual elements; including 36 temperature compensating (dummy) gages, 91 longitudinal gages, 91 transverse gages and 51 rosette gages.

Types A-3, single element, and AR-2 three element (rosette), gages were chosen for this installation. These are constantan wire, general purpose gages, with a grid length of 13/16 inch and bonded to a thin paper base.

Installation of Gages. After the array location was marked and gages spotted, an area about 6 inches square was sanded lightly and polished smooth. Gages were mounted with a household cement using a small fixture for the single element gages so that each gage of the pair was exactly 90 degrees from the other. Each pair of gages was soldered to lead wires by use of a common wire on all gages less than 10 feet above the ground; separate leads were used on all others.

Heat lamps were employed to dry the cement when indications of moisture were detected. Rosette gages had a common wire soldered to one side of each element on gages near the ground. The individual leads to all elements of gages located more than 10 feet above the ground was used to decrease loss of elements.

Six Coats Water Proof Gage Array. After the cement was thoroughly dried, the assembly was covered with a coat of alkyd resin and four or five coats of neoprene. A final coat of petrolene wax completed the waterproofing. Lead wires were secured to the pipe with a nylon cord. This procedure has successfully protected the gages through two winters and a summer. Deterioration after 18 months exposure appears to be negligible.

Compensation for Temperature Changes. Temperature compensating gages, also Type A-3 gages, were mounted on 6-inch steel squares cut from the same size of pipe and attached to the line pipe with steel banding. These gages were treated the same as actual test elements.

Temporary tubular building scaffolding was set up to install arrays in the desired positions on the vertical pipe. A cage type scaffold was used to locate arrays further out on the horizontal bridge pipe itself. Safety belts were employed at all times during the installation of gages in the upper reaches.

Running Lead Wires. The problem of bringing lead wires to the terminals was solved by using No. 19 gage plastic covered wire in a 32-strand

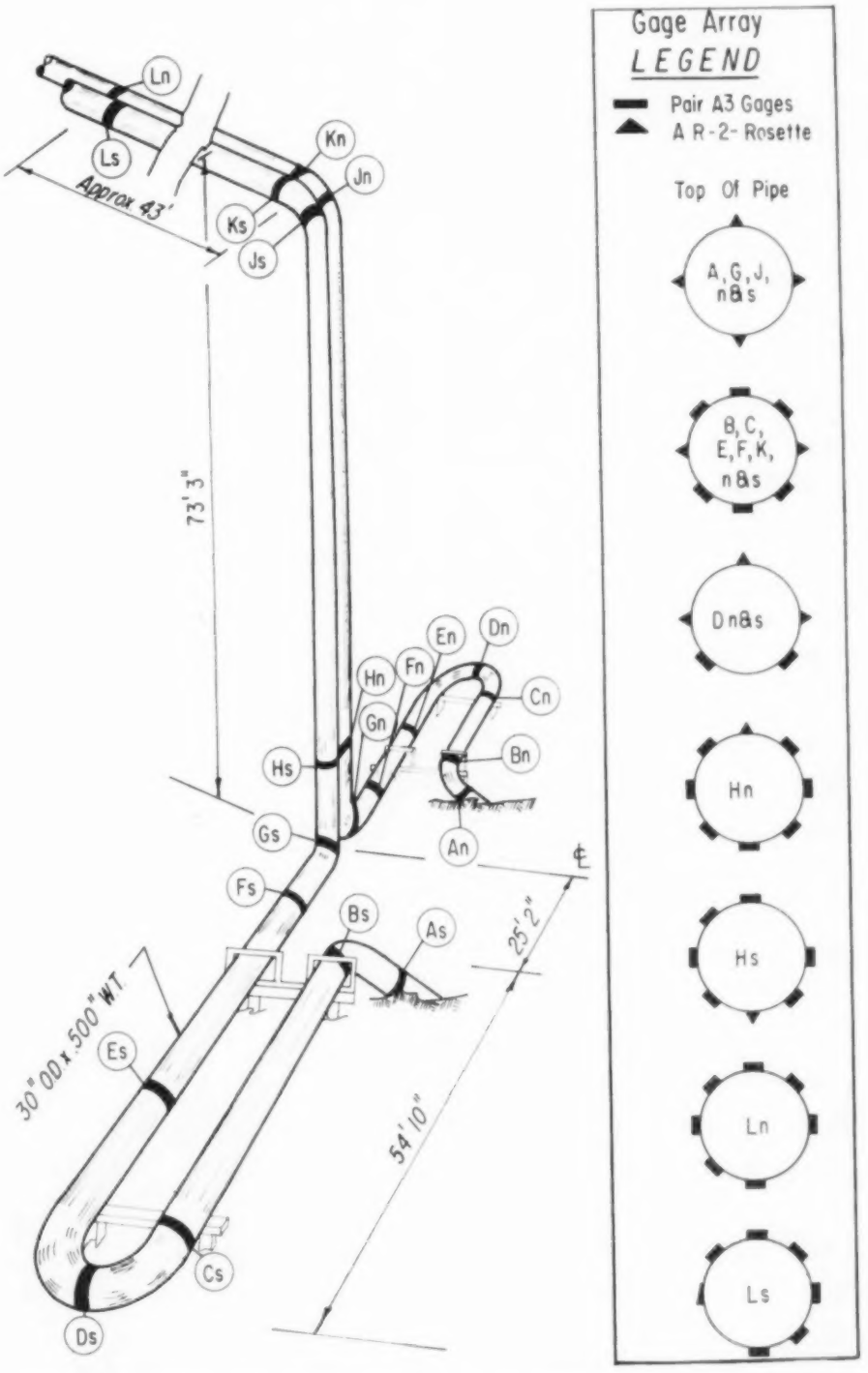


FIGURE 2—Eleven gage arrays were located at potential stress areas on the last straight length of bridge piping, downcomers, the 75-foot hairpin bends and the angle bend into the ground. Similar arrays were placed on both the north and south carrier pipes on the Illinois side of the river. Sketches show types of arrays used at specific points.

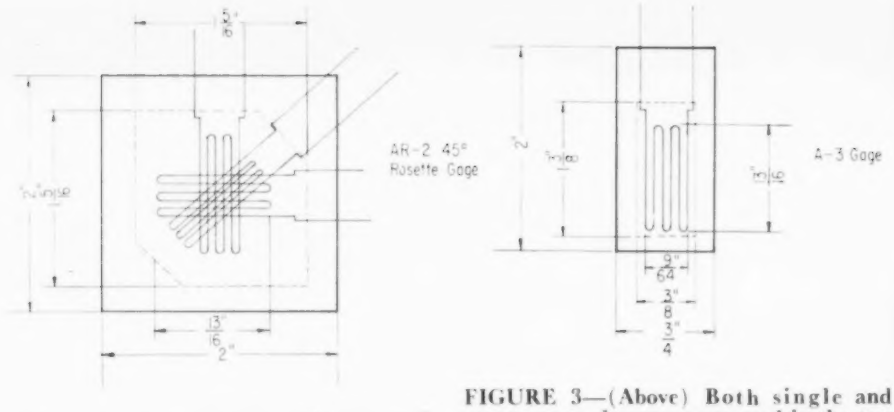


FIGURE 3—(Above) Both single and rosette gage elements were used in the test arrays on the bridge piping. Type A-3, single element, and AR-2, rosette elements are constantan wire, general purpose resistance gages with a grid length of 13/16-inch. Wire is bonded to a thin paper base.

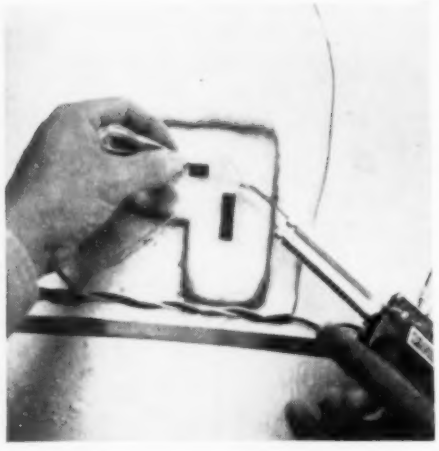


FIGURE 4—(Right above) Ordinary household cement was used to fasten the strain elements to the sanded and polished pipe surface. Single gage on steel coupon between the two arrays is a temperature compensating element installed at each location on top and bottom of pipe.

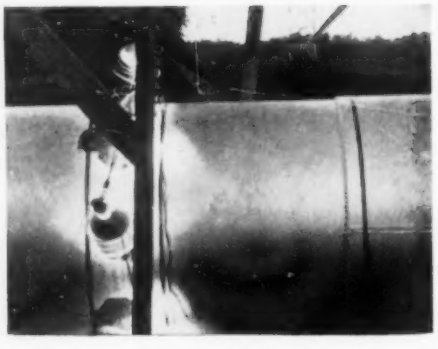


FIGURE 6—Where there were indications of moisture around the gage after cementing, a battery of heat lamps were used to dry the cement prior to waterproofing of the array.

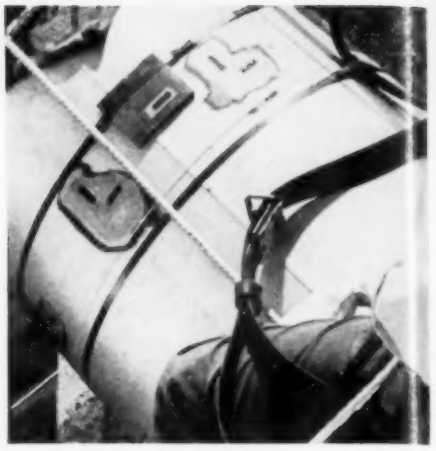
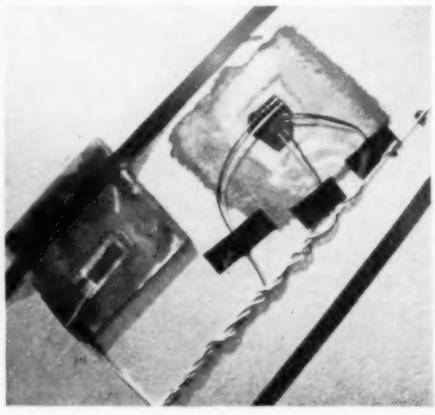


FIGURE 5—(Left) Each pair of gages was soldered to lead wires by use of a common wire on all gages less than 10 feet above ground. Individual leads to all others reduced the possibility of loss of elements.

heavy duty cable. For support, the cable was secured to the bridge ladder, clamped between drilled wood yokes and attached by means of steel banding. This method of clamping held the cable firmly without excessive crushing pressure.

Since lead cables were of an accountable length, a cable factor was required in addition to the gage factor supplied by the manufacturer of the gages. This compensated for the additional resistance offered by the cable.

Readings are taken at intervals throughout the year, thus producing data on a complete annual temperature cycle. A 6-foot by 6-foot instrument house was erected at the base of the bridge in a protected spot. All leads were brought to this shelter and attached directly to switching cabinets. To prevent moisture accumulation and keep relative warmth in the house, a 200 watt heat lamp burns constantly. This lamp provides sufficient heat with the least possible danger of fire.



FIGURES 7 and 8—At left is a three-element rosette gage showing lead arrangement with a common wire. An identical strain gage at right has a pair of wires soldered to each element.

Specially Built Switch Units. Commercial switching units of adequate size were not available so it was necessary to construct these items. It was decided to construct switching capacity requirements in several units rather than one large unit. This was done, not only for ease of handling, but also because the individual units, after completion of this program, could be used on smaller installations.

Units were constructed with two and four selector switches. Each selector switch can accommodate 24 gages; it has two wafers to accommodate the two leads from each gage. Silver plated contact points reduce contact resistance to a minimum and introduce a reproducible contact resistance of less than 0.001 ohm. Solder connections were used. Switches are connected in parallel for continuity of operation; one hook-up of the indicator unit, permits the reading of all gages connected to that particular cabinet.

Temperature Compensation Switching. A double-throw knife switch was used with each selector switch to introduce a temperature compensating gage into the circuit for each of the active gages of an array. After a number of operations, it was found that the knife switches introduced an apparent error because of poor contact. To minimize this con-

FIGURES 9 and 10—Three coats of neoprene have been applied over one coat of alkyd synthetic resin, shown in Figure at left. A final or top coat of petrosene wax has been poured on array at right.

dition, knife switches were replaced with terminal lugs.

Gage Reading Procedure. Prior to each reading of the gages, a vacuum tube ohmmeter test is made to measure the resistance to ground of each gage and to check for broken circuits. Resistanee to ground of each gage should normally be in excess of 50 megohms. In actual tests, it was found that all gages showed a resistance to ground of at least 300 megohms which increased after a few months of weathering to above 500 megohms. This increase is attributed to further drying of the gages as they aged; it is probably due to the fact that the pipe under operating conditions is warmer than the surrounding air.

Strain gage readings are taken at about three-week intervals throughout the year. Each reading consists of one complete set of measurements taken during the day and a companion set taken next night. Such readings are necessary to evaluate properly the data and to provide orientation factors for analysis of the data. Added information recorded at the time of each reading includes: date, ambient temperature, pipe temperature, gas pressure, wind velocity and weather conditions, ("clear," "sunshine," "cloudy," "rain," "snow" etc.).

Strain gage readings have been taken for the past year and one half. During that time practically all gages have maintained resistance to ground relatively equal to that found at the installation of the gages. Based on this indication and on the consistency of readings taken, it appears that the methods used for the installation of gages will be satisfactory for the full three year test. —**The End**

FIGURE 11—(Right) Cage type scaffolding was nested between dual 30-inch lines for work on horizontal section of bridge piping. Safety belts were worn during installation of gages on upper reaches of bridge.

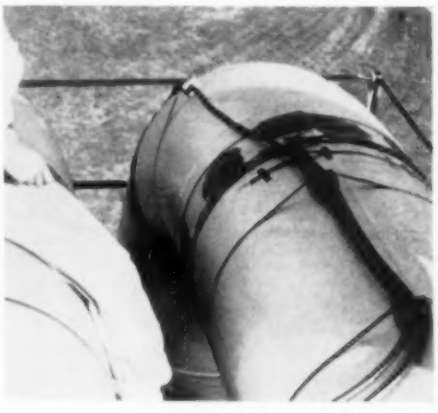


FIGURE 12—An array of two rosettes and six pairs of single gages were installed at the location of maximum stress on top bend of downcomers. Gage lead wire runs from top of bridge, secured by means of drilled wooden yokes clamped onto the pipe with steel banding. This method supported cable runs firmly without excessive crushing pressure.

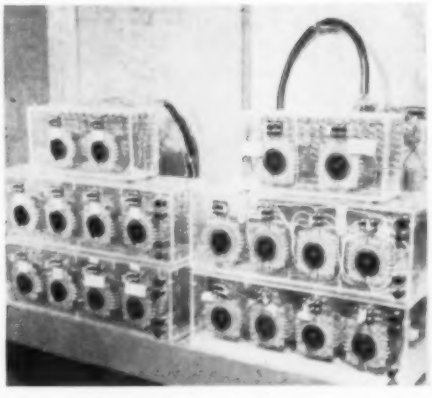


FIGURE 13—Switching units were assembled especially for the Texas Illinois bridge tests. Several small units were used rather than one large one, both for ease in handling and possible future use on smaller test installations. Switch banks consist of either two or four selector switches; each selector can accomodate 24 gages. Silver plated points maintain contact resistance to a reproducible value less than 0.001 ohm.

About the Authors

Barkow

Clark

A. G. Barkow, superintendent of inspection for Texas Illinois Natural Gas Pipeline Company and its affiliate Natural Gas Pipeline Company of America has been active in metallurgy and welding research for more than 25 years. Since joining the two pipe line firms in 1940, he has worked on the inspection of their construction projects and several field welding studies. During this time Barkow has served on committees of AGA, API, ASME, AWS and authored several papers published by the industry's technical publications.

D. E. Clark, engineer in the engineering and inspection departments of Texas Illinois and Natural Gas Pipeline, is a graduate civil engineer from the University of Nebraska. Since joining the two firms in 1947, he has been active in stress analysis studies, representing the companies in the AGA secondary stress analysis program. Clark is a member of the Society for Experimental Stress Analysis and is active in the technical program of its Chicago section.

FIGURE 1—Parallel passes on 4-foot centers is the most effective ripping pattern for most conditions when preparing the ground for trenchers. Two tractors with mounted rippers loosen rocky desert soil.

Ten Tips On Ripping

These ideas developed by contractors can pay off in faster, safer ditching and right-of-way work.

By J. J. Keyes
Caterpillar Tractor Company
Peoria, Ill.

SUCCESSFUL RIPPING as a pipe line construction technique has been advanced by recent developments in large hydraulically controlled rippers mounted on the rear of crawler tractors in the over 300-horsepower class. Their use in pipe line right-of-way preparation can provide contractors with faster ditching at lower cost by taking advantage of these benefits.

1. *Proper use of tractor and ripper weight:* With tractor-ripper weights approaching 70,000 pounds, the only limitations on depth of penetration are the size and strenght of the ripper and the tractive effort of the tractor.

Unlike the towed rippers, the tractor mounted ripper allows much of the weight of the tractor to be concentrated on the tooth for maximum penetration and effectiveness.

2. *Detection of underground rock formations ahead of ditcher:* By ripping well ahead of the ditching machine, underground rock can be spotted in time to remove it by further ripping or blasting. This advance warning saves costly delays and time-consuming repairs to ditching machines.

3. *Most effective ripping patterns:* In several different types of soil ranging from rocky desert right-of-way to frozen mine overburden, the most effective ripping pattern was parallel passes on approximately 4-foot centers.

4. *Make multiple passes:* In frozen overburden, the first pass was made with a tooth penetration of 6-inches to loosen the surface and provide more effective traction for succeeding deeper passes.

5. *Experience is best teacher:* There is no definite rule to tell what rock can be ripped and what cannot. In rock that can be successfully ripped, experience indicates that over-all costs will be even less than low-cost, ammonium nitrate blasting methods.

6. *Consider costs carefully:* Although rock ripping as a substitute for blasting is classified as a severe operating condition for cost estimation, resulting savings often greatly exceed added cost of increased wear on machinery. A crawler tractor in the 300-plus-hp mounting a ripper can generally be operated for $22 per hour. This includes all owning and operating costs and the operator's salary. One enthusiastic job superintendent claims ditching savings paid for the equipment in 30 work days.

7. *Safety benefits are important:* Contractors can also appreciate the safety returns of ripping over blasting methods where practicable. Lower insurance rates may often apply where ripping is substituted.

8. *Northern marsh work:* A contractor faced with the problem of laying pipe in swamp land on the line that spanned the Straits of Mackinac elected to wait for the winter freeze and use a ripper rather than use dredging methods in the summer months. Frozen marsh land is a good example of areas where ripping can pay off on unusually tough jobs.

9. *Speeding dozing operations:* Addition of a mounted ripper to a right-of-way clearing tractor can also offer savings in addition to ditching benefits. A few passes with the ripper will dislodge stubborn, hard-to-doze material to speed clearing work.

10. *Break-up of overburden:* In ripping frozen cover, passes should be made to break material into chunks that can be easily handled with shovels or backhoes. In deeply frozen mine overburden, an 8-foot ripper produced a spalling action, chipping and cracking the material so that it was broken up in pieces as if hit by a large hammer. —**The End**

Chart Simplifies Dew Point and Hydrate Formation Problems

It is useful for determining the water content of natural gas up to 10,000 psia and at temperatures of –50° F. to 300° F. Gravity and salinity corrections are included.

By John J. McKetta and Albert H. Wehe
Department of Chemical Engineering
The University of Texas, Austin

MANY INVESTIGATORS have studied the saturation water contents of natural gases at elevated pressures. In addition the dew point compositions have been determined for pure components such as methane[10], ethane[11], propane[4], butane,[12] and others.

In Figure 1 is shown a general chart for the water content of various natural gases. This chart is based essentially on the work of Dodson and Standing[2] who worked with a natural gas with a gravity of 0.65. The chart shown in Figure 1 has been corrected to a gravity of 0.60. The extension to low temperatures was taken from the work of McCarthy, Boyd and Reid[7], who used the low temperature experimental work of Skinner.[13] On the chart in Figure 1, additional data were used from the work of Deaton and Frost[1], Hammerschmidt[3], Laulhere and Briscoe[6], and others.

Hydrate formation region. The dotted line on Figure 1 shows the hydrate formation conditions. The equilibrium at temperatures below the hydrate formation temperatures is between the gas and solid hydrate rather than the equilibrium between the gas and liquid which exists at temperatures above the hydrate formation conditions. The first to point out this discrepancy were Kobayashi and Katz.[5] There is a slight change in slope of the lines below the hydrate formation temperature, however, it is hardly noticeable.

Correction for different gravity. McKetta and Katz[9] working with the methane-butane-water system showed that the amount of water required to saturate a gas depends on the molecular weight (hence the gravity) of the gas. They were able to vary the composition of their gas mixtures so they could approximate gas gravities ranging from 0.58 to 1.9. They also incorporated the results of the methane-water system[10], ethane-water system[11] and butane-water system[12] to increase the range of gravities from 0.55 to 2.0. They showed that a correction factor for gas gravity was a function of the temperature of the gas. This correction factor is shown on Figure 1 under the title "Correction for Gas Gravity" and is called, C_G where:

$$C_G = \frac{\text{lbs. water in Gas of Gravity, G}}{\text{lbs. water in Gas of Gravity of 0.6}}$$

Correction for salinity. Dodson and Standing[2] published extensive data on natural gas-water and natural gas-brine systems. They used brines of different concentrations and were able to determine the effect of salinity on the dew point compositions of the gas. McKetta and Katz[8] also presented a correction for the salinity of the brine on the dew point compositions of the natural gas-water systems.

In Figure 1 there is a "correction chart for salinity" from which the salinity correction factor, C_S, is obtained.

$$C_S = \frac{\text{lb. water in gas if gas had been in contact with brine}}{\text{lb. water in gas if gas had been in contact with water}}$$

Sample Calculation. A natural gas, Gravity = 0.9 is in contact with brine in a reservoir. The brine contains 30,000 ppm solids (approximately 3 percent NaCl). The pressure of the gas is 3000 psia and the gas temperature is 150° F. How much water is in the gas in pounds of water per million cubic feet of gas (measured at 60° F. and 14.7 psia)?

Solution: (a) Follow dashed lines on Figure 1. From the general chart of Figure 1, at 3000 psia and 150° F. a 0.6 gravity gas would contain 105 pounds of water per million cubic feet of 0.6 gas, if the gas had been in contact with pure water.

(b) Correction for gas gravity from 0.6 to 0.9: From the "correction chart for gravity," follow the dashed line from the abscissa where the desired gravity is 0.9, vertically, to the 150° F. isotherm. Read horizontally, the C_G, correction factor for gas gravity, = 0.98.

(c) Correction for Salinity of Brine: See the second correction chart on the general Figure 1. At a brine salinity of 3% go vertically to the correction line and read on the ordinate the value of $C_S = 0.93$.

Final Answer: 105 lbs. water × C_G × C_S = 105 × 0.98 × 0.93 = 95.6 lbs. water in the gas. The experimental value for this gas was 96.2 which is within the desired accuracy.

TURN PAGE FOR CHART ►

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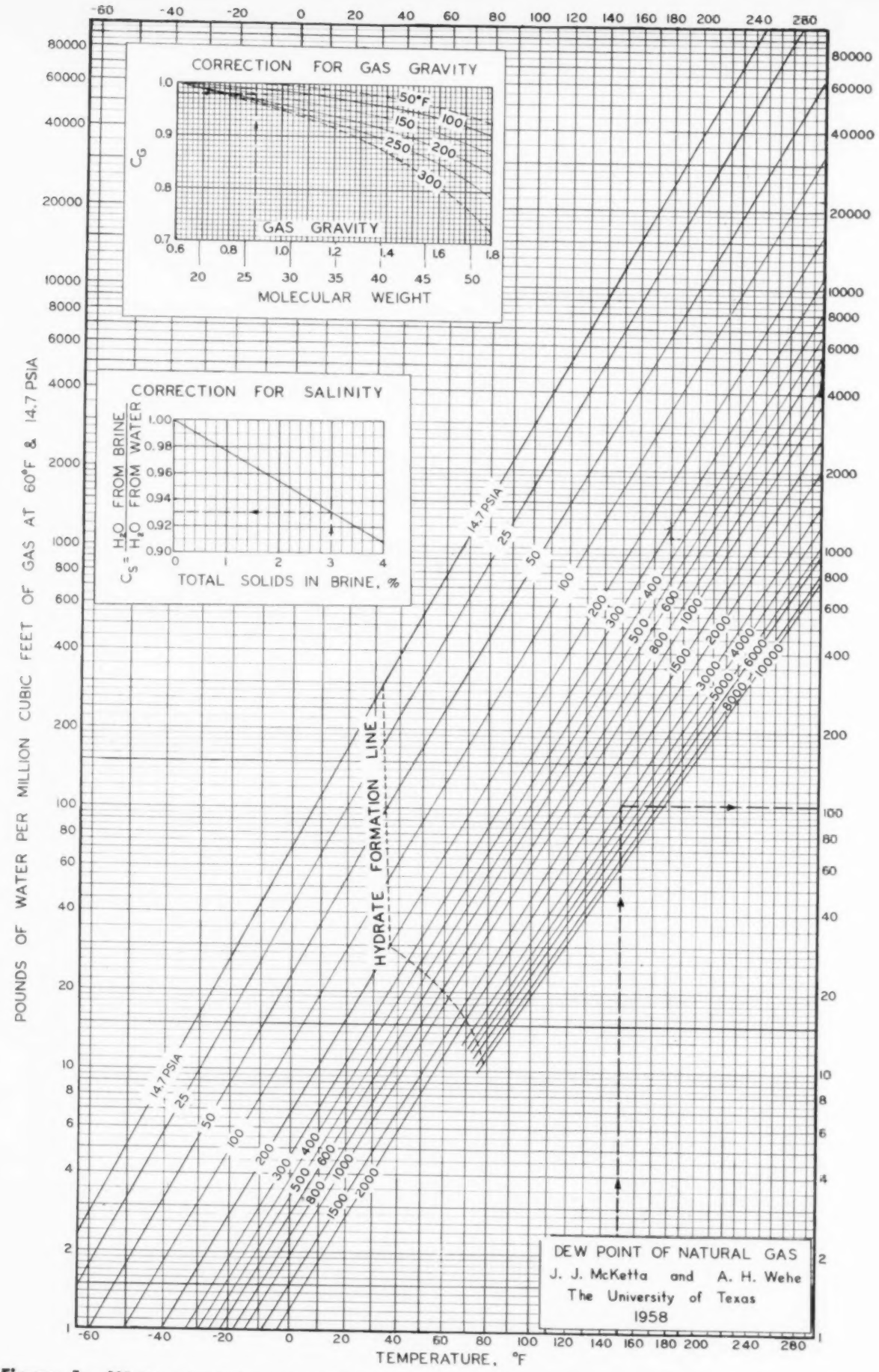

Figure 1—Water contents of natural gases with corrections for salinity and gravity.

—The End

Let's Look at Rectifier Efficiencies

Careful analysis of these factors when designing an impressed current system will get the most protection for the power dollar spent.

By Ray M. Wainwright
Good-All Electric Mfg. Company, Ogallala, Neb.

MAJOR SOURCES of energy losses in cathodic protection rectifiers are the rectifier cell losses and those losses resulting from ripple power characteristics. In a single-phase, full-wave rectifier, these losses are about equal. But in a three-phase unit, the rectifier cells are the principal users of electric power. Additional small losses also may be accounted for in the transformer and internal circuits of the unit.

The efficiency of cathodic protection rectifiers is a term which has many times in the past been misinterpreted and misunderstood. Normally, the term means the ratio of output power to input power in any energy conversion or transmitting device, usually expressed as a percentage. Thus,

$$\% \text{ Efficiency} = \frac{\text{Output power in KW}}{\text{Input power in KW}} \times 100 \qquad \text{(Eq. 1)}$$

The only trouble with this definition is that it is too broad, and needs to be qualified—what output power, and what input power, should be considered?

Major Energy Losses. If the efficiency figure is less than 100 percent, we know, of course, that the energy conversion device is itself an abstractor of energy from the system, or in other words, the various parts of the device have net energy losses. This is very true of all cathodic protection rectifiers. The principal sources of cathodic protection rectifier losses are:

- Transformer losses—these losses are conversions of energy to heat in the core and windings of any transformer or chokes present.
- Internal circuit losses—these losses are in the wiring and electrical contacts, and are again, conversions to heat.
- Rectifier cells—rectifier cells convert energy to heat in two ways. The resistance of the cell to the forward load current creates an I^2R loss, and the resistance of the cell to the reverse leakage current creates another I^2R loss. In most dry plate metallic rectifiers, such as are used in cathodic protection work, the losses caused by the forward load current are substantially the larger of the two. In any case, such losses tend to depend upon the current loading of the rectifier, and may be somewhat dependent on the voltage rating in a rather non-linear fashion.
- The losses due to "ripple power"—any rectifier which is not well regulated, or which does not have a large number of phases, does not have a uniform d-c output, but has instead a pulsating output waveform. Analysis shows that powerwise this output is equivalent to a uniform direct current plus a group of harmonic frequencies above the usual 60 cycle fundamental. Some of the power is in the direct current output and some is in the various harmonics. Since the cathodic protection processes may normally be assumed to be affected only by the direct-current power, the power in the harmonics, or "ripple power," is non-useful and must be considered in the same category as the other losses. In fact, the ripple power is actually wasted as heat or in a-c electrolysis in the ground bed, earth, cables, and piping systems.

Each of these four sources of losses combine to give us the usual efficiency figure for cathodic protection rectifiers, which can be defined as the Cathodic Protection

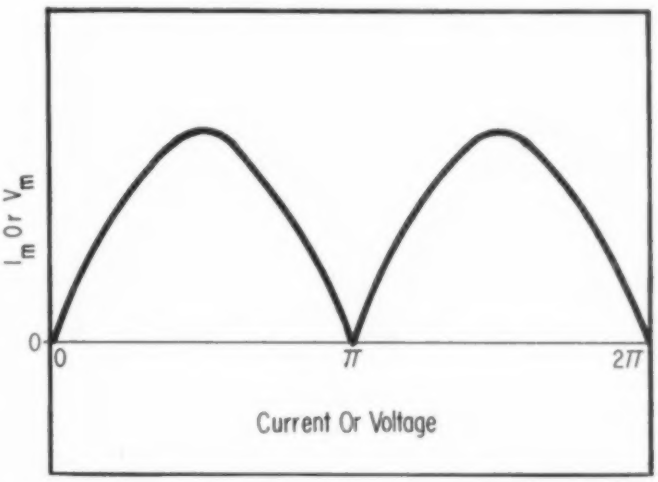

FIGURE 1—Idealized output waveform (100 percent rectifier cell efficiency) for single-phase full-wave bridge rectifier.

Rectifier Efficiency (CPR Efficiency) or as usually referred to in the literature as "Conversion Efficiency."

$$\text{CPR Efficiency} = \frac{\text{Product of D'Arsonval d-c voltmeter \& ammeter reading out}}{\text{a-c wattmeter readings in}} \times 100 \qquad \text{(Eq. 2)}$$

Transformer Losses can be approximated by observing the a-c watts input when operating the transformer at rated input voltage, with the secondary winding open-circuited. These losses consist principally of magnetizing current losses and core losses. To these must be added the copper losses obtained by energizing the primary windings at low voltage and operating the transformer at rated secondary current, through a short-circuited connection. Compared to other losses in the rectifier, the transformer losses are usually quite small, and the efficiency of the transformer, which can be defined as:

$$\% \text{ Transformer Efficiency} = \frac{\text{a-c watts out}}{\text{a-c watts in}} \times 100 \qquad \text{(Eq. 3)}$$

may run from 95 percent to 98 percent in the average rectifier.

Internal Circuit Losses are quite small in a well-constructed rectifier, and can be minimized by sizing conductors and terminals properly, by silver-plating contacts, by maintaining adequate contact pressures, and by the use of proper solders and fluxes. Such losses probably decrease efficiencies by small fractions of 1 percent if the rectifier is in good condition, and has not developed hot spots at terminals or contacts.

Cell Losses. In selenium, germanium, and silicon rectifier cells, the cell losses contribute a major item in the over-all efficiency. Most of these losses, as has been stated previously, occur because of the forward current. This is especially true in silicon and germanium cells. In a single-phase selenium rectifier of around 1 to 2 KW capacity, the rectifying plate efficiency may be, for example, around 80 percent for medium voltage ranges (from 20 to 50 d-c volts). This efficiency increases somewhat at higher voltages, and drops away to about 50 percent at from 3 to 4 volts d-c rectifier output, and is near zero at fractions of a volt d-c output.

It is because of this plate efficiency decrease that very low voltage d-c rectifiers are inherently inefficient pieces of equipment.

Ripple Power Losses. The final source of losses which are inherent in the ripple power characteristics of the rectifier may be calculated by observing the output waveform of the rectifier and determining the difference between the total power in the wave and the d-c power component of the wave. By means of Fourier Series analysis, the power may also be computed in each of the harmonics. An analysis of the ripple power problem follows, first for the single-phase bridge rectifier, then for two three-phase cases.

Assuming a single-phase full-wave bridge rectifier stack operating into a purely resistive load, the idealized wave (100 percent rectifier cell efficiency) will be as shown in Figure 1. The total power in the wave will be,

$$P_1 = \frac{1}{T}\int_0^T p_1(t)\,dt = \frac{1}{T}\int_0^T v_1(t)\,i_1(t)\,dt \qquad \text{(Eq. 4)}$$

where $v_1(t) = V'_m \sin(\omega t + \phi)$

and $i_1(t) = I'_m \sin(\omega t + \phi)$

For the resistive case, and where $(\alpha = \omega t)$ and $(\phi = 0)$,

$$P_1 = \frac{V'_m I'_m}{2\pi}\int_0^{2\pi} \sin^2(\alpha + \phi)\,d\alpha = \frac{V'_m I'_m}{2} \qquad \text{(Eq. 5)}$$

The rectifier waves have a Fourier representation of:

$$v_1(t) = \frac{2V'_m}{\pi} - \frac{2V'_m}{\pi}\left(\frac{2}{3}\cos 2\omega t + \frac{2}{15}\cos 4\omega t + \frac{2}{35}\cos 6\omega t + + +\right) \qquad \text{(Eq. 6)}$$

and,

$$i_1(t) = \frac{2I'_m}{\pi} - \frac{2I'_m}{\pi}\left(\frac{2}{3}\cos 2\omega t + \frac{2}{15}\cos 4\omega t + \frac{2}{35}\cos 6\omega t + + +\right) \qquad \text{(Eq. 7)}$$

Power in the waves must again be as in Equation 4 with the two series substituted for $v_1(t)$ and $i_1(t)$.

Integration of the product of the two infinite series shows that P_1 is the sum of the products of the constant coefficients, plus the products of the coefficients of the harmonics divided by 2, and 1 multiplied by the cosine of each harmonic power factor angle. Since we have assumed a resistive load, each power factor angle is assumed to be zero, and

$$P_1 = \frac{V'_m I'_m}{\pi^2}\left(1 + \frac{2}{9} + \frac{2}{225} + \frac{2}{1225} + + +\right) \qquad \text{(Eq. 8)}$$

The first term is the d-c power component, therefore the total ripple power is given by

$$P_r = (P_1 - P_{dc}) = \frac{V'_m I'_m}{2} - \frac{4I'_m I'_m}{\pi^2} = (0.1896)\,P_1 \qquad \text{(Eq. 9)}$$

In a similar fashion, the ripple power can be computed for each harmonic as shown in Table 1.

Nearly 18 percent of P_1 is taken up by the 120 cycle ripple power and around 1 percent by all the other harmonic powers. Also note a single-phase full-wave rectifier, with rectifier cells having 100 percent efficiency and with a 100 percent efficient transformer, would have an over-all efficiency of only 81 percent.

Power Content of Half Wave Rectifier. The three-phase half-wave case can be analyzed similarly. Utilizing the symmetries in the waveform of Figure 2, the total power in the wave is given by

$$P_2 = \frac{3V''_m I''_m}{2\pi}\int_0^{\frac{5}{6}\pi}\left[\sin\left(\alpha + \frac{\pi}{6}\right)\right]^2 d\alpha = I''_m V''_m\,(0.7065) \qquad \text{(Eq. 10)}$$

The Fourier representation for the load current and voltage is in the complex variable form:

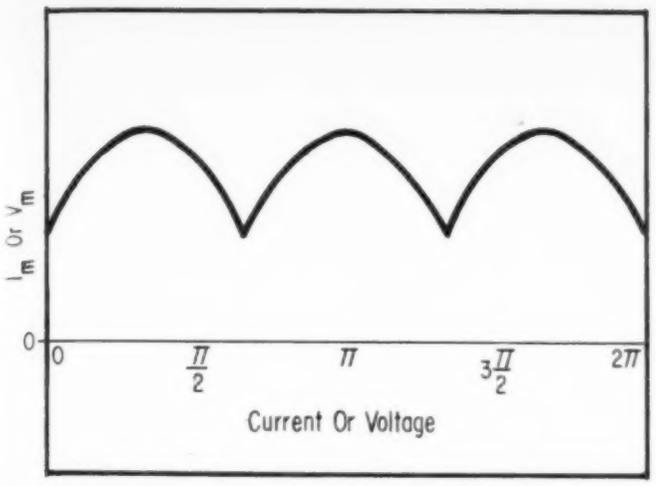

FIGURE 2—Idealized output waveform for three-phase half-wave rectifier.

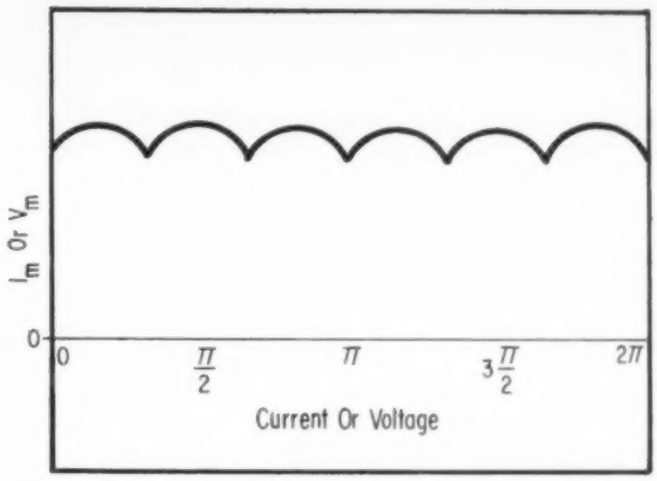

FIGURE 3—Idealized output waveform of three-phase bridge rectifier.

$$V_2(t) = jV''_m(0.8263) + V''_m(0.2065)\varepsilon^{j\phi 3}\varepsilon^{j3\omega t} + V''_m(0.0689)\varepsilon^{j\phi 4}\varepsilon^{j4\omega t} + \quad + \quad + \qquad \text{(Eq. 11)}$$

$$I_2(t) = jI''_m(0.8263) + I''_m(0.2065)\varepsilon^{j\phi 3}\varepsilon^{j3\omega t} + I''_m(0.0689)\varepsilon^{j\phi 4}\varepsilon^{j4\omega t} + \quad + \quad + \qquad \text{(Eq. 12)}$$

From these Equations, Table 2 can be constructed showing the harmonic power content of the three-phase half-wave rectifier.

Multipliers for Bridge Rectifier. The wave form of the popular three-phase bridge type rectifier is shown in Figure 3.

Total power in this wave is given by the expression:

$$P_3 = \frac{V'''_m I'''_m (6)}{2\pi}\int_0^{\frac{\pi}{3}}\left[\sin\left(\alpha + \frac{\pi}{3}\right)\right]^2 d\alpha = (0.9135)\ V'''_m I'''_m \qquad \text{(Eq. 14)}$$

The dc component power can be found by first applying the Fourier Series analysis for the zero frequency components of voltage and current. From this analysis, the complex terms are:

$$\left.\begin{aligned} V_{m_0} &= jV'''_m\frac{3}{\pi} \\ \text{and } I_{m_0} &= jI'''_m\frac{3}{\pi} \end{aligned}\right\} \qquad \text{(Eq. 15)}$$

DC power is then the product of the j-coefficients,

$$P_{dc} = V'''_m I'''_m\frac{9}{\pi^2} = (0.9119)\ I_m V_m \qquad \text{(Eq. 16)}$$

The results of these equations can now be expressed as shown in Table 3.

While 81 percent of the single-phase rectifier total power output was usable for cathodic protection, 96.5 percent of the three-phase half-wave rectifier total power output is usable, and 99.8 percent of the three-phase bridge output is usable.

The final conversion efficiency from Equation 2 is now a combination of all the four types of energy losses. Figure 4 shows a statistical trend study on the single-phase full-wave and the three-phase bridge-type selenium rectifiers which shows full load conversion efficiency plotted against d-c voltage output of the rectifiers. The prominent breaks in the curves are caused by the necessity to change from single cells to series cells at around 28 volts d-c output. Similar breaks should occur at changes in the voltage rating on the selenium cells and the triple and quadruple series arrangement of cells at the higher voltage. However, these effects are smoothed out by the combining of different types of cells in various series arrangements, and no further prominent breaks are noted.

Individual rectifiers may vary as much as ±5 percent or more from the curves of Figure 4 due to variation in transformer and cell characteristics. Some units have certain favorable specifications such as single transformer primaries or particularly good cells which are conducive to higher efficiency. Therefore, the efficiencies of some machines may be considerably above average. Figure 4

TABLE 1—Ripple Power Multipliers for a Single-Phase Full-Wave Rectifier

P_{dc}	$= 0.8104P_1$
P_{60}	$= 0$
P_{120}	$= 0.1780P_1$
P_{180}	$= 0$
P_{240}	$= 0.0071P_1$
P_{300}	$= 0$
P_{360}	$= 0.0013P_1$
P_{420}	$= 0$
P_{480} and up	$= 0.0032P_1$
P_{total}	$= 1.000P_1$

TABLE 2—Ripple Power Multipliers for a Three-Phase Half-Wave Rectifier

P_{dc}	$= 0.9650P_2$
P_{60}	$= 0.$
P_{120}	$= 0.$
P_{180}	$= 0.0302P_2$
P_{240}	$= 0.0032P_2$
P_{300} and up	$= 0.0016P_2$
P_{total}	$= 1.000P_2$

TABLE 3—Ripple Power Multipliers for a Three-Phase Bridge Rectifier

P_{d-c}	$= 0.99825P_3$
P_{60}	$= 0$
P_{120}	$= 0$
P_{180}	$= 0$
P_{240}	$= 0$
P_{300}	$= 0$
P_{360} and up	$= 0.00175P_3$
P_{total}	$= 1.000P_3$

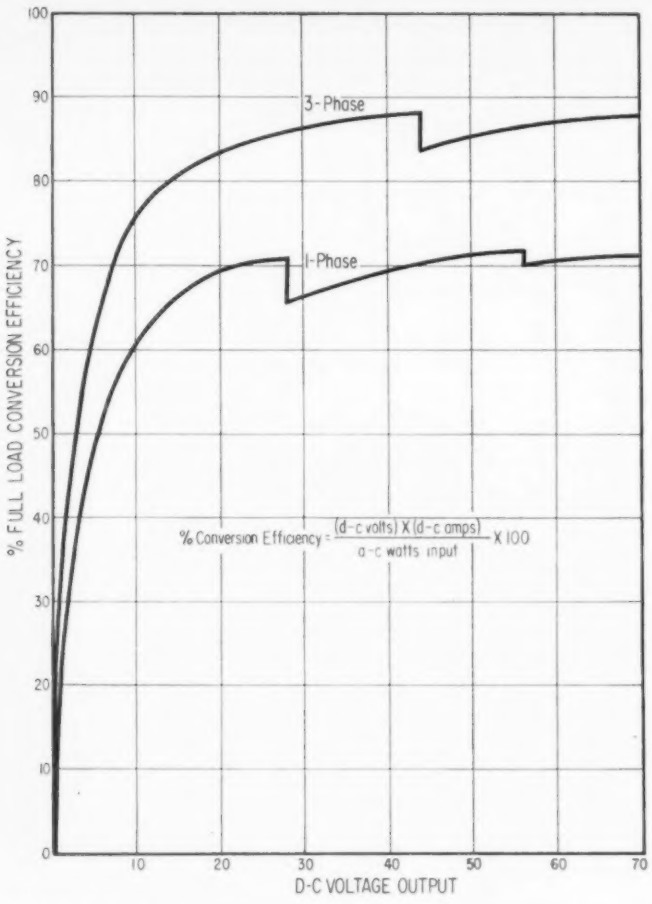

FIGURE 4—Statistical trend study of a large group of cathodic protection rectifier efficiencies. Selenium plates, Class "A" transformers, and dual winding primaries.

shows efficiencies from new selenium plates; aging characteristics of selenium plates may drop these curves as much as 10 percent or more in some cases.

Silicon Cell Performance. So far, the use of silicon cells in cathodic protection rectifiers has been limited, but there is every reason to believe that these semiconductor materials will find an increasing use in cathodic protection work, and may even replace selenium entirely in at least some ratings in the near future. Cell efficiencies for silicon are in general higher than those for selenium, and tests so far show almost negligible aging characteristics. These features, coupled with much smaller physical dimensions and higher operating temperature abilities, make the silicon-powered units very attractive for future applications.

Cutting Power Costs. Where a CPR efficiency of a single-phase selenium unit might be 62 percent, the equivalent silicon unit may give efficiencies around 70 to 72 percent. This efficiency increase can be evaluated more exactly as follows:

Assume a unit of 2 KW output operating on 3 cents per KW hour of power with an efficiency of 62 percent. If the equivalent silicon powered unit has a 70 percent efficiency, the saving in power would be

$$\frac{2{,}000}{0.62} - \frac{2{,}000}{0.70} = 365 \text{ watts.}$$

This has an annual monetary value of

$$0.365 \times 0.03 \times 8640 = \$94.60 \text{ per year.}$$

Assuming a 4-year payout, this would capitalize at around $378 which is the additional amount that could be spent to purchase an equivalent silicon rectifier. Since it is not likely that silicon rectifiers will have this cost differential above selenium, some substantial savings are in prospect.

Filter Applications. Another source of potential savings on single-phase rectifiers is the increasing of efficiency by conversion of ripple power to useful d-c output. The most likely means of accomplishing this is by the use of a filter. If the dissipation factor of the filter is not too bad, the filter can substantially pay for itself in increased efficiency, and at the same time, communication interference hazards are diminished.

If the filter could increase the overall efficiency by even another 8 percent, in a 2 KW single-phase rectifier, it might be worth from $200 to $400 on a capitalized basis, depending on the cost of power. The maximum increase in efficiency would of course be about 18 percent, but this figure could never be met due to filter losses, cell losses, etc. The practical maximum is 12 percent for selenium, and 16 percent for silicon rectifiers.

Since the maximum practical gain in efficiency by filtering in a three-prase rectifier of any type is less than about 2 percent, there seems to be little gained efficiency-wise by the use of a filter on three-phase units. The only justification for a filter on a three-phase unit would be to eliminate communication interference.

REFERENCE

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About the Author

Ray M. Wainwright was formerly an associate professor of electrical engineering at the University of Illinois. He has worked as an electrical engineer for power companies on corrosion problems and has taught courses in electrical circuit analysis and engineering economics. Wainwright is active in technical affairs of the AIEE and NACE, has been responsible for short courses on cathodic protection given each year at his school. He has published many papers on engineering economics including cathodic protection. He has a BS in electrical engineering from Montana State College and an MS from the University of Illinois.

FIGURE 1—Service Pipe Line Company's Laura Station illustrates the modern trend toward open-air pump stations. It includes, besides the four motor-driven pumps under the canopy, control and office buildings and shop. Increased safety, savings in initial investment, and saving in overall station maintenance were realized. Three of four motors were converted from standard indoor design to weather-protected type.

Open Air Pump Stations Cost Less To Build, Are Cheaper To Maintain

Cost of new outdoor installations can be reduced by converting indoor motor to weather-protected design.

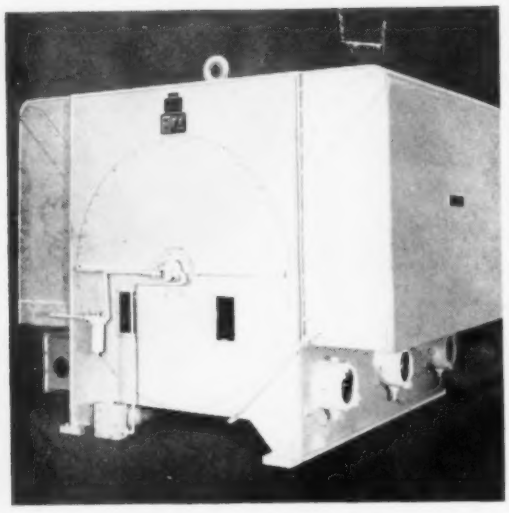
By A. L. Crichton, Application Engineer
Elliott Company, Ridgway, Penn.

IN MODERNIZING its main line system, Service Pipe Line Company has switched to outdoor stations. This move was made possible by the development of weather-protected motors. Investment costs were reduced at several installations by converting standard indoor motors to the weather-protected design. Outdoor machinery gives increased safety, savings in initial investment, as well as savings in overall station maintenance.

New stations have been of two basic designs: units on open slab protected by a canopy with permanent hoist, and completely open with no cover over the pump slab. Except at single-unit unattended booster stations, a small control office and shop are built a short distance from the pump slab.

Conversion of Indoor Units. In converting the round-frame motors to weather-protected type, the old oil tank, lubricating oil cooler, and filter were first removed. With the type of water separation provided by the outdoor unit, it was only necessary to give the windings an additional treatment by completely immersing the ends of the coils and baking. A new square frame was built and adequately secured to the round frame by internal bracing. The new frame was arranged so that lifting strain was taken by the heavy members of the old frame.

The standard arrangement of water separation chamber was provided, but an oil-to-air heat exchanger was placed in the intake to the chambers to provide lubrication oil cooling, thus eliminating the need of water. This was important when the motors were to be used in a dry location where extremely low temperatures are en-



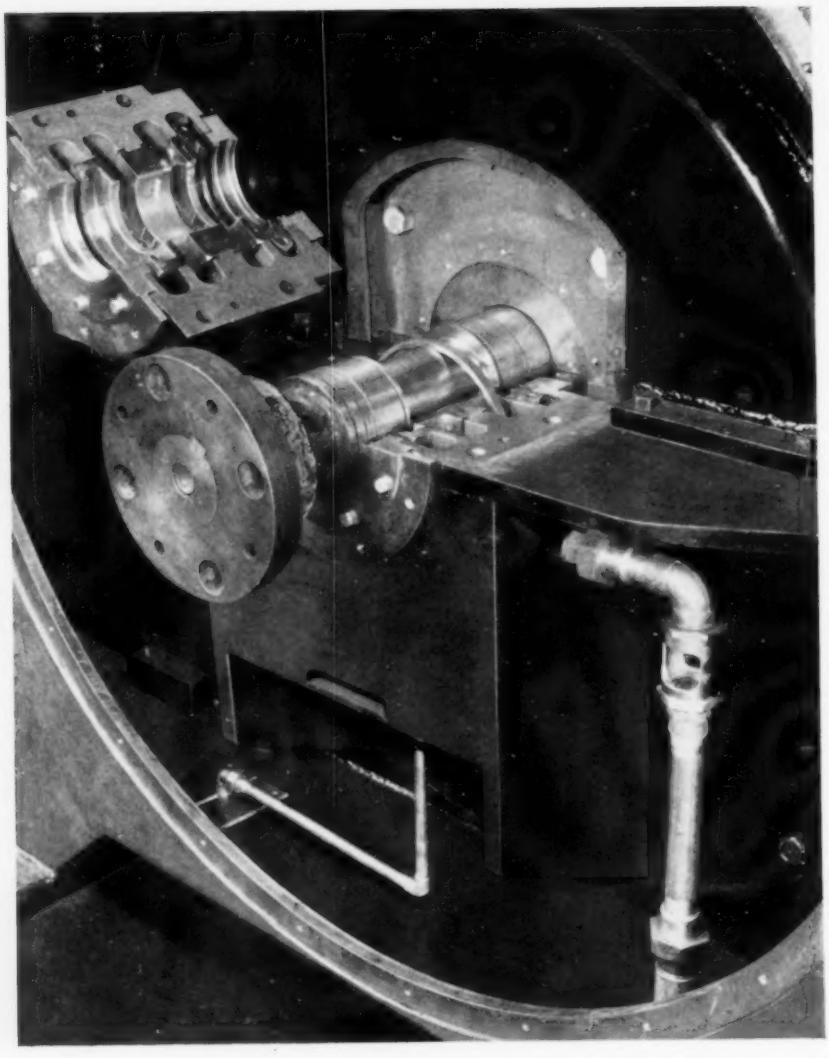


FIGURE 2—At several installations investment costs were reduced by converting standard indoor motors to weather-protected design. At left, above, is a motor of the type rebuilt, before conversion. Left, below, is the same round-frame indoor-type motor as converted to weather-protected construction. At right, is the coupling end of the converted motor showing old bearing bracket, end of enclosure and sight flow gage.

FIGURE 3—Pump slab at new Laura Station. Included are two 2-pole, 1,500-hp and two 2-pole 1,250-hp weather-protected squirrel-cage induction motors driving centrifugal pumps. Electric heating cable in slab melts snow and ice.

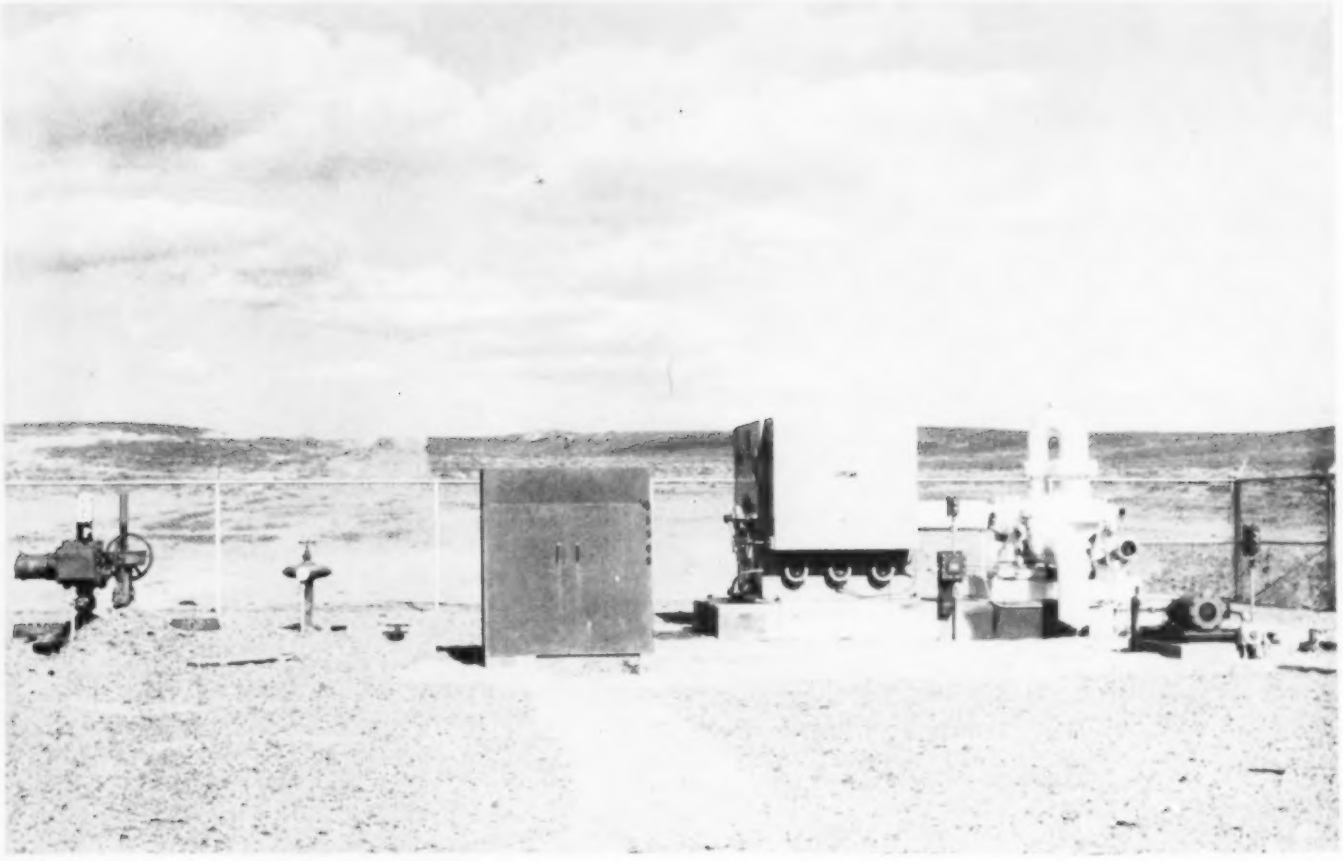


FIGURE 4—Installation at Big Muddy Station in Wyoming is not covered. A 1,500-hp, two-pole 3,600-rpm squirrel-cage, weather protected induction motor is direct-connected to a two-stage, centrifugal pump. Motor bearings are flood-lubricated by a self-contained system which includes a geared pump, oil filters and air-to-oil cooling system within the motor housing. Temperature detectors protect both bearings and motor windings. Space heaters inside the motor enclosure are energized when the motor shuts down, preventing moisture condensation. Relays and controls are in explosion-proof enclosures.

countered. Air filters were provided to clean the ventilating air.

Lubricating oil storage was provided by a round tank under the frame. The ends of these tanks can be modified for the insertion of immersion heaters to keep lubricating oil warm when extremely low temperatures prevail. Explosion-proof bearing and oil pressure relays were provided because of the location in a hazardous atmosphere. Sight flow oil gages were provided. The bottom air discharge is the same as in standard weather-protected motors.

Covered Slab Stations. Typical of the covered slab stations is the station at Laura, Ill. The canopy over the motor-driven pumps permits the use of a hoist and gives some desirable protection from the sun. Trouble had been caused by direct sunlight which in some cases was hot enough to trip thermal devices. Both slab and canopy extend far enough to give a working area around the pumping units. Copper-clad electric heating cable embedded in the concrete slab provides heat for melting snow and ice.

In the modern outdoor installation at Laura there are four pumps driven by 1500-hp and 1250-hp, 3600-rpm, weather-protected induction motors. One of these was originally built as a weather-protected type and three were rebuilt from standard indoor design. Motors were returned to the factory for conversion.

Uncovered Stations. Construction was simplified further in Wyoming. Here no canopy or large capacity traveling hoists were provided. The only permanently installed lifting devices are jib cranes to remove the pump case and impeller assembly.

Service Pipe Line has built several single-unit unattended booster stations in the 1400 and 1500-hp class. It has also completed four 1250-hp single-unit outdoor electric centrifugal relay stations which are remotely controlled.

Where it is not necessary to have an attendant, housing has been kept at a minimum. A small frame and corrugated-asbestos cement building is used to house the sequence control cabinets and remote supervisory control equipment. —**The End**

About the Author

A. L. Crichton, is a graduate in electrical engineering from Ohio State University. After working in the Engineering department of the Dayton Power & Light Company, he joined Elliott Company in 1946 and served as a field engineer in the Cleveland and Detroit district offices. Crichton has been an application engineer specializing in induction motors at the Ridgeway, Penn., plant of Elliott Company for the past five years.

Lick Those Technical Writing Problems

If, for instance, you are writing a report and you just can't get down on paper what you want to say, then you're fighting the battle of words and facts. Here's how you can win!

By W. A. Sylvester, The Standard Oil Company (Ohio), Cleveland

VERY OFTEN engineers have a misguided humility about their writing. They overlook the fact that technical matters are hard to write about, no matter how literate one may be.

That is why "practical" advice about writing is not necessarily helpful. Even if such advice helps one engineer, it may not help another, who has equally complex but entirely different problems. An engineer can find his own practical solutions, if he understands the difficulties he faces, for the ability to put theory into practice is the essence of an engineer's professional training. Consequently, this brief sketch about the problems of technical reports will be unashamedly theoretical.

Suppose a layman is writing about an automobile; the work vaguely suggests a four-wheeled vehicle. Then he adds details—station wagon, turquoise, bent fender, up front, right etc. Soon the details create a description so vivid it will apply to only one car.

But what happens when the engineer or technician talks of an automobile? He speaks of cubic inches of displacement, of brake mean effective pressure, of horsepower. The details are specific, but they do not create a visual image.

In the technical report, specific details tend to remain abstract—is there any wonder why we have difficulty?

Sometimes It's Easy. Fortunately, engineers do not always have problems in preparing reports. We should understand why some reports are easy, so that we can see why others are difficult.

Engineers have little difficulty with the body of a straight-forward chronological account. One describes the stocks selected, the tests run, the data noted. The report may not be dramatic, but it is clear and orderly—exactly what it is supposed to be.

Nor does an engineer have difficulty in describing equipment. He starts at one end, describes the components as they appear spatially until they are all accounted for.

Neither does he have trouble in following a process—from the gasoline in the tank, through the lines, the filters, the carburetors, and so forth, to the exhaust.

If he wants to, he can completely reverse the pattern of these organizations. He can start with the exhaust and work back to the gasoline, or he can start at the other end of the equipment and describe the components in an entirely different direction.

These patterns—chronological, spatial, or functional—are easy to handle and easy to manipulate. They

"When we write about technical matters, we are going against the normal tendency of the language . . . Technical matters tend to be abstract; abstractions look alike; we have difficulty in distinguishing between the generic and the specific."

are relatively easy at least, because there is no conflict between language and technical matters. An arrangement in actual time, or space, or both, corresponds to an arrangement of words, and so the engineer can organize his report.

However, when he turns to the introduction or to the conclusion, even for a simple report, he can run into difficulty. Just *why* was the project started? Just *what* does it mean? The moment he has to say something *about* technical matters, he interrupts the pleasing one-to-one relationship between technical matters on the one hand, and words or symbols on the other.

The Reader Intrudes. "What is this all about . . . for me?" says the report reader who may be primarily interested in the feasibility of production, costs, or the "newness" of the project. He does not wish to go through every detail, and so the engineer must relegate some areas to footnotes or to appendixes. He must view the report from a different angle. He must cover some ground swiftly, and other ground in great detail.

He does this by using different kinds of words. Some words are inclusive, and cover a large area of meaning; these are generic words. Other words are narrow, and cover a small area of meaning; these are specific words. "Petroleum oil" is generic; Diesel fuel is specific. These words are generic and specific only in relationship to each other. "Petroleum oil" is no longer generic, but specific when compared to the word "liquid."

Words that are relatively generic not only cover ground swiftly, they also establish frameworks that define large areas of significance. In writing a summary of a report, one may wish to refer to "petroleum oil," diesel fuel, a kind of diesel fuel, or a specific property of diesel fuel, depending upon the reader's interest or technical background.

A distinction between generic and specific words will help us restate our work for the benefit of other people. Such distinctions will also help us to organize our reports; we will not jump back and forth between inclusive concepts and narrow ones. We will write in a consistent and orderly way.

The Art of Creating Images. We do not have much trouble organizing our writing about everyday matters. We can easily arrange our words into a consistent pattern from the generic to the specific, or the other way around. We can either make a general statement and back it up by details, or we can start with details and lead to a broad, general conclusion.

Suppose, for example that we are writing, as laymen, about automobiles. The word suggests vaguely a four-wheeled vehicle. We can then add details—a station wagon, turquoise, a bent fender, up front, on the right, white-side walls, and so forth. By adding enough details, we create a description so vivid it would apply to only one automobile.

Normally, therefore, specific details create vivid concrete images, but notice what happens when a technician speaks about an automobile. He talks of cubic inches of displacement, of brake mean effective pressure, of horsepower. These details are specific, but they do not create a visual image. Nobody can ever see the cubic inches of displacement, not even with a cutaway model. The specific details remain abstract.

Let us take the word "gasoline". This common word is generic and inclusive. It carries with it vague images of many kinds of gasoline, of liquids with a pungent smell. If we become technically more specific and talk of normal heptane, or isooctane we do not create a visual image that will correspond to our higher degree of specification (although we may imagine an irrelevant change of color). If we become more specific still, and talk of 2-2-4-trimethyl pentane, we have not added a single visual element.

To be sure, technical terms may be familiar to the technician, but they remain abstract. The automotive engineer may think of a precise engine, when given the cubic inches of displacement, but such an image is associated with the measurement; it is not the measurement. Likewise, one can illustrate the "meaning" of 2-2-4 trimethyl pentane by making an image with a tinker toy. Such models can be helpful, but they are just ways of explaining an essentially abstract concept. In technical matters, our visual referents are often related only indirectly to the fact.

In everyday usage, generic terms tend to be vague; specific terms, vivid and visual. When writing about technical matters, we find that specific terms remain abstract.

Consequently, when we write about technical matters, we are going against the normal tendency of the language. Small wonder we have difficulty.

Technical matters tend to be abstract; abstractions look alike; we have difficulty in distinguishing between the generic and the specific.

Specific but Abstract. The mind works more easily with physical images. Lacking any physical images to work with, the engineer is hard put to make distinctions which will help him sort his material.

Worse still, even when he can distinguish degrees of generalization technically, these degrees may not correspond to similar degrees in words. We can see this discrepancy best if we turn to mathematics.

Let us take a simple arithmetic statement: $3(2)^2$. We can say that this is less inclusive than the more general statement: $3(x)^2$. The algebraic statement includes $3(2)^2$ and many other arithmetic statements as well. Likewise, the statement $n(x)^{n-1}$ is more generalized still. Notice that it is more generalized mathematically. In actual practice, however, the arithmetic statement could control a vast number of details, such as the pricing of panels sold in thousands of colors and textures. The generic formula could be a minor detail about one particular rate of flow at one time. Put into words, the generic statement in mathematics, becomes specific.

The patterns of generalization in technical matters do not necessarily correspond to a pattern of generalization which is useful in a report.

What Can be Done? The engineer can ask himself some questions about

his data. Let us take a simple example. Suppose an engineer has to write a description of a newly developed solvent. His first sentence might be:

"This high K. B., medium cut, aliphatic naphtha has a high flash."

There is nothing wrong with this sentence (except that the engineer would put down the actual figures). It is easy to understand. To quibble about a single sentence would be pedantic, and is offered solely to save space. But even in so short an example we can see that the organization, if extended to the entire data sheet, would be:

Solvency—kauri butanol
Distillation range
Hydrocarbon content
Flash point

Throughout an entire report, the jumbled organization would be distressing. So suppose he were to write instead:

"This naphtha is aliphatic, medium cut, with a high K. B. and a high flash."

The progression form the generic to the specific is consistent. Extended to the entire report, the organization would be:

Hydrocarbon content
Distillation range
Solvency
Flash point

Hydrocarbon content is generic, flash point is specific.

"Naphtha" establishes an area, and "aliphatic" cuts it down. "Medium-cut" restricts it even more, in this context.

Technically speaking, the difference of generalization between "medium cut" and "aliphatic" is minute, if not impossible to see. As a matter of fact, one can get an equally consistent pattern, merely by changing the words:

"Of the medium cut naphthas, this aliphatic . . ."

The difference lies in the way the words are used.

Notice, however, that K. B. is *technically* more generic than flash point. The solvency includes more properties than the volatility of the light ends.

The K. B. value may be more *generic,* but it is not necessarily more *significant.*

Indeed, for many reports we would find the flash point of greatest importance and might wish to mention it first. The specific detail, the flash point, might easily have a general interest for many applications.

And so the engineer has three questions to ask:

1. Is there a verbal pattern of generalization?
2. Is there a technical pattern of generalization?
3. Is there a pattern of generalization that lies outside of the report? (The interest of the reader.)

We have then three areas, and two directions to go:

AREAS
Words or symbols
Technical facts
Reader's viewpoint

DIRECTION
Specific
Generic

Areas. There is no easy way to distinguish between the generic and the specific. The ability to do so is vital to one's life of the mind. To make the attempt is to find new interest in one's work, and possibly to render the work easier in the long run.

By jotting down some reminders, the engineer can possibly mark out rough areas (which for some reason or other seem to be called "ball parks" today).

What is the mathematical pattern? What is the verbal pattern? How generic is this datum? How many other data does it control or influence? Given this datum, will the reader have a general or a specific interest in it?

Which Direction? Suppose we can distinguish between the generic and the specific, what then? In which direction should we go?

Two rules of thumb may prove helpful: put specific abstractions first, when they are self-explanatory and cumulative, so that they lead to a new, and unfamiliar generalization. Put a general, explanatory framework first, if the specific abstractions are hard to understand.

In other words, whenever possible move from the familiar to the unfamiliar.

If the engineer can see the conflict between words and technical matters, more than likely he can often find his own answers. I wish that I could honestly say that he can always find his own answers.

Sometimes A Consistent Report Is Impossible. This is a fact and we must admit that sometimes nothing can be done. Sometimes the reader simply cannot have an easy report, because the subject matter is insuperably difficult.

We cannot change the structure of the English language at will. We can not alter the entire Geneva system for the convenience of a single report. We cannot alter reading habits.

Your reader, for example, may be used to reading a report in this way:

He sees a formula at the beginning of the report. He jumps to the end, to see if he is interested in the report at all. He goes back to the middle, to see what the formula is leading up to. He works back to the list of mu's, rho's and sigma's to see what they mean. He takes these, plugs them into the formula, and is ready to start.

If you put the significance first, he will be left staring at a strange formula on the last page, and will be irritated at the engineer for not putting the incomprehensible first, the comprehensible last.

If the engineer can reduce the number of these cases to a minimum, he will be much happier. Even when he comes upon an impossible case, he will do the best he can, and realize why he could do no better. That should save him emotional energy and time. As we said, many engineers have a far greater ability to write than they realize. —**The End**

About the Author

William Sylvester is technical publications editor for Standard Oil Co. (Ohio). He has had experience in editing, writing, and consulting for bulletins, brochures, engineering reports, and technical articles. He received his B.A. degree from Columbia College in 1940, his M.A. degree from the University of Chicago in 1947, and a Ph.D. degree from the University of Minnesota in 1951. He is a member of the Society of Technical Writers and Editors.

How Do You Rate as a Conference Leader?

By Dr. Robley D. Stevens
Management Consultant, Washington, D. C.

YOU HAVE just emerged from a conference where you and your associates spent three hours in stimulating discussion, and where a good workable solution was found to your operating problems.

You think of how different it was from the one last week—the one that started 30 minutes late and where most of the time was spent in hashing out trivial matters and losing sight of the real problem. Nothing was really settled and when it was time to leave there was a mad scramble for the door and the general feeling of, "whew—I'm glad that's over."

Why, though, should there be so much difference in meetings? Why are some so fruitful while others are for the most part failures? Obviously the leader is the big factor, and regardless of how it may appear to you, a successful business conference doesn't just happen—it is the result of careful planning and thoughtful leadership.

What Is a Conference? A conference is a meeting for finding answers to a question or solutions to a problem. It is a pooling of the knowledge and experience of a group of individuals. Of course, all conferences, then, are meetings with a definite purpose or objective, but not all meetings are conferences. The difference is well worth examining.

Obviously, there must be a discussion as well as an objective in every business conference so that a decision will be reached. However, in every well-conducted business conference, the conclusion or solution should be based on a complete and thorough investigation of all phases of the topic or problem under discussion, as this promotes clear thinking among those who participate.

A conference with a real problem should adapt itself to group discussion—it must present a challenge—and solving the problem should be a satisfying experience to the group.

You—The Leader. What, exactly, are some of your duties as the conference leader? What is expected of you? Obviously, the first thing you must do is to get the conference started. As the leader, you should tell your group the purpose of the conference. You should demonstrate that it is a real business problem, perhaps, an urgent one. If you put the problem before them in such a way you will arouse their interest, motivate their thinking, and create in each of them a desire to do something about the problem.

You don't have to be a genius or superman to be a good conference leader but there are certain traits which are desirable. For instance, you must enjoy working with people. You should have confidence in your group and be convinced it can carry on an intelligent discussion and arrive at a logical solution. You should be able to express your thoughts clearly and in a language which your group can understand. You should be able to think rapidly and clearly. You must keep a step ahead of it, sense its trends, and see where the discussion is heading.

Everyone who works with people on a pipe line, and particularly one who leads them, can find that a sense of humor is a real asset. Pointing to the lighter side of a problem will often relieve a tense situation. Thus, you should make full use of your talents, and, realize that self-restraint, tact, courtesy, and patience will help you. Your own zest and enthusiasm should

be real, apparent, and contagious. You must get the individuals to work as a group so a solution to the problem will be found.

You and the Problem. You must consider the facts and conditions of the problem to arrive at an accurate appraisal of the situation. In defining your operating problem, you should consider criteria for evaluating results. These criteria are the yardsticks for measuring your solution. For instance, ask yourself these pertinent questions:

Will this solution produce the desired results?

Will it actually do the job?

Do your operations have the means for accomplishing the job this way?

Is the solution going to cost our company too much?

Can we afford it?

You will have to rely on your good judgment and common sense to tell you when you have sufficient information to give you a clear picture. You will use operations sales reports, production charts, cost analysis figures, special studies, etc. as among your tools, but guard against gathering too much irrelevant data.

Now you should consider the solutions to your problem. After you list all possible solutions, consider the implications of each. This is the "If I do this, what will happen?" approach. If, of course, the solution you select passes the test, you have solved your problem.

Ask Questions. The success of your conference will depend to a large degree on your asking the right question at the right time. A direct question enables you to draw out information from your group. You will need follow-up questions to keep your business conference going. The primary purpose of your questioning is to encourage group thinking on the topic or problem. Thus, you will have to consider the effect of your question by asking clear and concise questions and, avoiding anything vague, indefinite, and ambiguous. In short, let your questioning be natural—don't think yourself a quiz master who knows all the answers.

Getting Ready. Obviously, you are unable to conduct a business conference without a group and a room. You should have good comfortable chairs, a large table, and sufficient paper, pencils, ash trays, etc. It's also a good idea to have a blackboard. An important advantage of this careful and detailed preparation is the confidence it gives you as the leader.

If you expect your conferees to study the problem before they come to your conference, you should prepare an agenda which might contain the following:

A statement of the problem.

A definition of it.

Your proposed plan of attack.

Be Prepared for Everything. Of course, anything can happen. No one can tell you exactly how you must handle trying or delicate situations which may arise. Much depends on your group, on you, and on the circumstances involved. Thus, you should not be totally unprepared.

You will be dealing with people—many different types of personalities. So you will have to skillfully handle such persons who won't talk; those who talk too much; the know-it-all; those who may oppose you; and the group who reaches the wrong conclusion.

After you have lead a few conferences, you will want to learn what progress you have made. Of course, you should, if possible at all, compare yourself with other people who have led a business conference. Thus, you should constantly check yourself, your preparation, and your performance. It's up to you to correct your own deficiences.

Evaluate Yourself. The self-rating chart listed below will aid you in making a detailed self-examination of yourself as a business conference leader. Place a check-mark by all questions you can answer with an unqualified "yes."

CONFERENCE LEADER EVALUATION GUIDE

Your Preparation
Did you . . .

—do a good job of planning and arranging the physical setting?
—make sure the conference started on time?
—check to see if you could adapt some of the pipe line training aids to the problem to be discussed?
—feel you had sufficient knowledge and background data?

Your Personal Qualities
Did you . . .

—feel poised, confident and in control of the group at all times?
—remember to talk so you could be heard and understood clearly?
—quickly grasp and develop pertinent points?
—feel actual enthusiasm and interest in the problem?
—see that the group generally "followed" where you lead?
—get along with all the conferees?

Your Leadership Techniques
Did you . . .

—arouse and sustain a lively interest in the problem and the quest for for its solution?
—make sure there was group understanding on all important issues?
—see that the discussion was not dominated by a few individuals, and that all members had the opportunity to express their views?
—state all of your questions clearly and concisely?
—keep the discussion on one point at a time?
—handle over-aggressive members skillfully?
—talk to the group rather than to individuals?
—refrain from lecturing?
—distribute the time so that minor issues did not get more time than they were worth?
—see that the group covered all essential items and issues?
—feel that the response indicated the conferees were really thinking about the problem?
—briefly summarize all important decisions just before the end of the conference?

The Results
Did conferees . . .

—solve the problem or reach any conclusions on how it could be solved?
—seem reluctant to leave?

Now you have a picture of yourself as a business conference leader. How do you rate? You shouldn't be satisfied with anything less than a definite and honest "yes" answer for every one of the questions.

Keep this rating and before you lead your next conference, refer to the list and make sure that you are well prepared. Then afterward, refer to it again to see how much you have improved. Remember, if your conference is good, you as its leader will share the prestige of that success.

—The End

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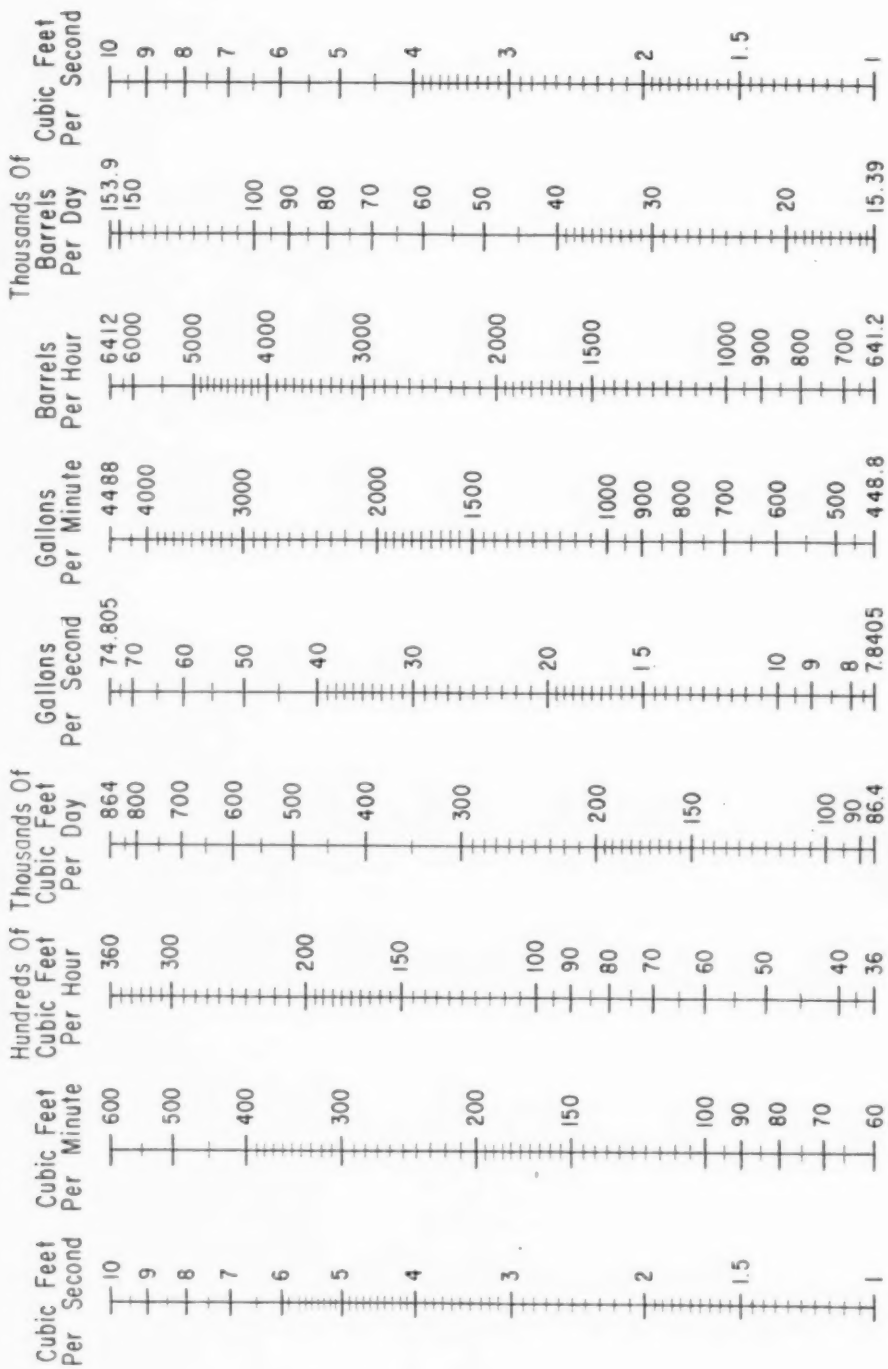
Engineering Design —49—Flow Conversion Chart



This line chart provides an easy method for converting units of volume flow. Simply draw a line perpendicular to the scale lines through a known value of flow and read the equivalent value on any of the other scales.

Idea submitted by:
Marvin H. Green,
Philadelphia

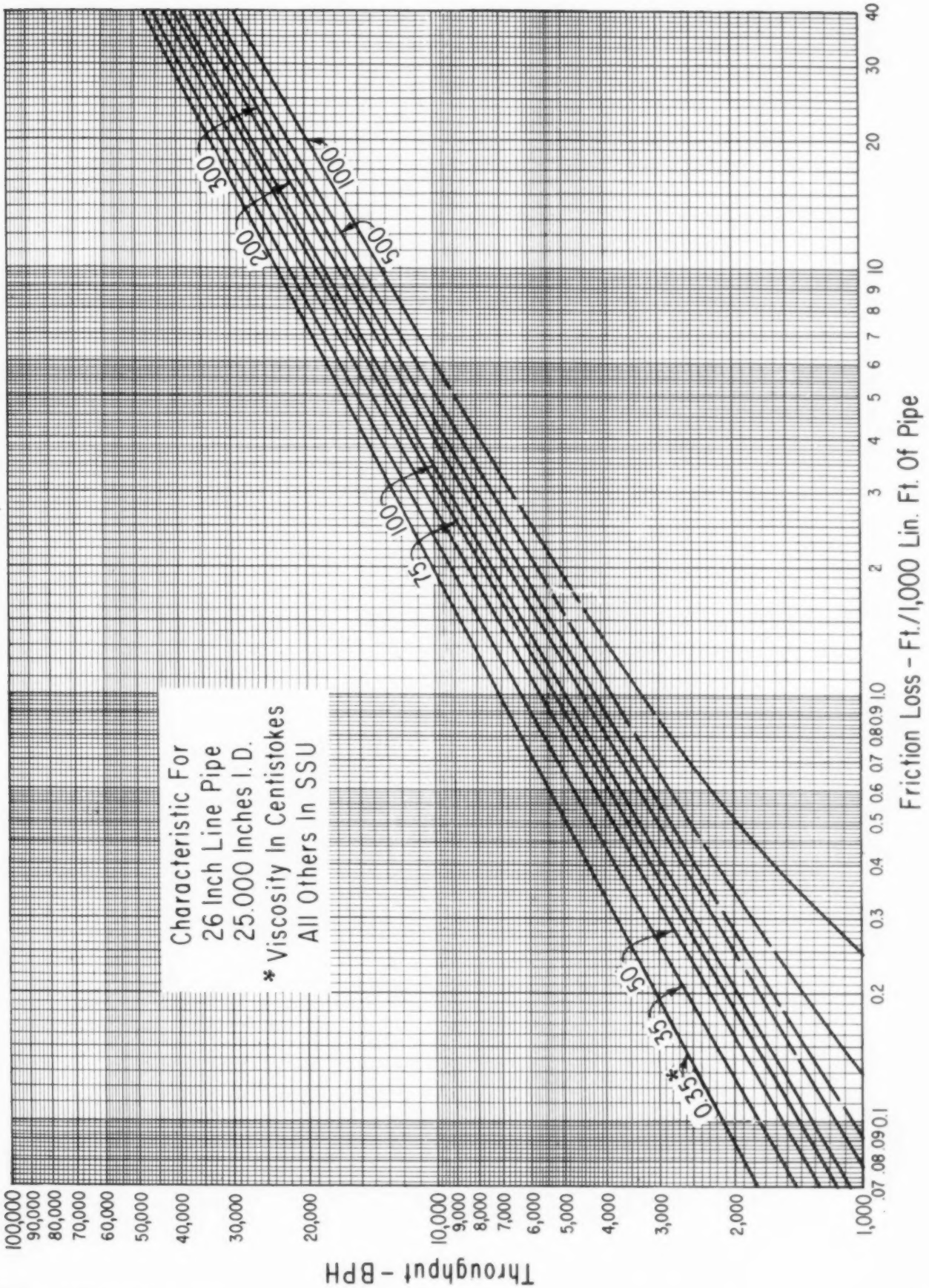
Engineering Design —50—

Head Loss Chart

Friction loss Characteristics for 26-inch pipe were computed by a pipe line company using data of the Hydraulic Institute. Use of these data in laminar and critical zones is adequate for estimates. Friction losses in transition and complete turbulent zones are very accurate.

(Chart 12 in a series of 19—26-inch line pipe)

ENGINEERING DESIGN 50



WHAT'S HAPPENING

IN PIPE LINE CONSTRUCTION

By Donald G. DePugh, PIPE LINE INDUSTRY Staff

Tennessee Gas to Start Construction On $169.3 Million Construction Project

Tennessee Gas Transmission Company has been granted authorization by a Federal Power Commission examiner for construction and operation of pipe line facilities estimated to cost $169.3 million.

The project includes construction of 1,072 miles of pipe line and 104,250 horsepower in compressor capacity, located in Arkansas, Kentucky, Louisiana, Mississippi, New York, Ohio, Pennsylvania, Tennessee and West Virginia. The largest portion of construction will be a 556 mile, 30-inch line extending from the Louisiana Delta to Portland, Tenn. A total of 265 miles of loops, paralleling sections of the company's existing system will be laid.

The application included 107 miles of lines extending to offshore stations. TGT has completed 89 miles from Kinder, La., to the Gulf and presently is constructing the final 18 miles. A total of 68 miles of loops in Pennsylvania and Kentucky also was constructed last year.

A 76-mile line will link compressor stations at Hamburg, N. Y., and Coudersport, Penn. Construction of compressor facilities will include eight new stations and additions at eight existing stations. The project is designed to increase Tennessee's average delivery capacity by 405.5 MMcf of gas daily, boosting it to 2,305 MMcf daily.

Contracts let on the main line to Portland include: Sharman Allen, Gay & Taylor, 27.7 miles, 30-inch in Lake Borgne Area, Louisiana; Houston Contracting Co., 38 miles of 30-inch, marsh and canal crossings. This extends from the Gulf to Ysclosky, La., southeast of New Orleans. Collins Construction Company, Mississippi River crossing at Happy Jack, La., 65 miles south of New Orleans.

Oklahoma Contracting Company, 90 miles, 30-inch from Columbia, Miss. to the Tennessee River.

Panama Inc., 117 miles, 30-inch, from Bay St. Louis, to Sandersville, Miss., Bechtel Corporation, 72-miles, 30-inch, Dickson to Portland, Tenn. Western Pipe Line, Inc., 80-miles, 30-inch, Florence, Ala., to Dickson, Tenn. Williams Brothers has the 76 miles of 24-inch from Coudersport, Penn., to Hamburg, N. Y.

Plantation Pipe Line Co. Plans 48-Mile Products Line

Plantation Pipe Line Company will construct a 48-mile 4-inch products line this summer which will parallel an existing line between Breman and La Grange, Ga.

The $1 million project will increase the capacity for pumping products available to Columbus and Macon. Plantation has already started work on installation of larger pumps, motors and auxiliary equipment at 12 pump stations on the Baton Rouge-Greensboro, N. C., system. When construction has been completed the capacity will be 334,000 bbl per day.

Texas Eastern to Acquire Facilities of Subsidiaries

The Federal Power Commission has been requested to authorize Texas Eastern Transmission Corporation to acquire and operate the natural gas pipe line facilities of two wholly-owned subsidiaries—Texas Eastern Penn-Jersey Transmission Corporation and Wilcox Trend Gathering System, Inc.

The application states that the subsidiaries will be merged into the parent company. Penn-Jersey facilities include about 263 miles of pipe line and 70,000 horsepower in compressor capacity located in five stations.

Wilcox Trend has about 389 miles of pipe line and 6,400 horsepower in two compressor stations. The facilities are all located in Texas and are used to transport natural gas for Texas Eastern from the Wilcox Trend producing area in south Texas Gulf Coast. They connect with Texas Eastern's main line in the Provident City, Texas, area.

Construction to Get Under Way Soon On Transco's 1958 Expansion Program

Transcontinental Gas Pipe Line Company will start construction on several projects this summer. Transco is awaiting final Federal Power Commission approval on its major programs and expects to get permission by August. When contracts are let, the following contractors probably will do the work.

Panama-Williams would have 100 miles of 24-inch in Pennsylvania from Picture Rock to the state line on Delaware River near West Pittston, Penn. From West Pittston 30 miles of 30-inch will be extended to Princeton, N. J.

Sharman Allen, Gay & Taylor will lay the final 65 miles of 24-inch which runs from a point northeast of Renova to Picture Rock where it will tie in with the section to be built by Panama.

Transco has also awarded a contract to H & K Construction Company to lay 32 miles of 6 to 8-inch gas line, including lateral lines between Pleasanton and Poteet in Atacosca, Texas.

Houston Contracting Company has contract for the Atchafalaya River crossing north of Melville, La. Two lines, 18-inch and 30-inch, will be constructed.

Transco recently received FPC approval to buy gas from 39 producers in South Louisiana and offshore Louisiana. The company plans to build 150 miles of offshore lines to take gas and deliver it to existing customers. Construction will begin soon on a portion of this project.

Ohio Fuel Gas Company To Develop Storage Field

Ohio Fuel Gas Company has been given temporary authorization by Federal Power Commission to develop a natural gas storage field located in Medina County, Ohio. Ohio Fuel plans to convert the depleted Medina gas producing area into an underground storage field.

The $5 million project will include construction of approximately 12 miles of 4½ to 20-inch pipe line and 3,300 horsepower compressor station. About 3 miles of small diameter pipe will be abandoned.

Ohio Fuel said that eight remaining active wells in the pool will be converted to storage service. Ultimate storage capacity is estimated at 8.5 billion cubic feet and peak day withdrawals would be in the range of 80 to 199 MMcf daily.

Service Lets 3 Contracts to Burden In Expansion of Wyoming Crude Lines

Service Pipe Line Company has awarded three contracts to O. R. Burden Construction Corporation on its crude line expansion program in Wyoming.

Burden will lay 47 miles of 12-inch line in Johnson and Natrona counties; a 17-mile section which extends from the Casper station northward toward Salt Creek station, and 30 miles of line connecting Salt Creek with the North Fork field, a producing area now without pipe line connections. The Salt Creek-Casper line will be increased by 10,000 bbl per day.

Burden will also take up and recondition 54 miles of 12-inch between Ft. Laramie station and Glendo Junction, in Goshen and Platte counties, and between Welch station and South Cole Creek Junction in Converse County.

Last month Service began its 1958 expansion project letting contracts to Burden on 76 miles of 20-inch between Casper and Ft. Laramie which will replace the 12-inch line to be taken up soon.

Other plans for Service include addition of approximately 11,500 horsepower to its 870 mile system between Elk Basin, Wyo., and Freeman, Mo. Three new pump stations will be installed at Herndon and Scranton, Kans., and at La Grange, Wyo.

With the completion of these facilities Service will have increased its capacity to 39,000 bbl per day.

Here is a breakdown on installations at new stations. At Herndon, two 2,000 hp dual-fuel diesel engines driving centrifugal pumps; at Scranton, an unattended outdoor station, with a 2,000 hp electric motor driven centrifugal: at La Grange, a 2,000 hp electric-centrifugal unattended station.

A third dual-fuel centrifugal pumping unit of 2,000 hp will be added to the two units at Laton station, in Rocks County, Kansas. Larger motors will be installed at the Elk Basin, Kirby, Owl Creek, and Lost Cabin stations, northwest of Casper for a total of 2,200 additional hp.

Texas Gas Seeks FPC Approval to Hike Gas Delivery by 13 MMcf Per Day

Texas Gas Transmission Corporation has filed an application with the Federal Power Commission seeking permission to increase its gas delivery capacity by approximately 113 MMcf per day.

Construction of 126 miles of pipe line and 9,040 additional compressor horsepower at existing stations is proposed by Texas Gas. The new pipe lines, which consist of 92 miles of 30-inch, 19 miles of 26-inch and 15 miles of smaller diameter, will loop portions of the company's existing system in Louisiana, Arkansas, Mississippi, Kentucky, Indiana and Illinois.

The additional horsepower will be installed at Pineville, La., Kenton, Tenn., Calvert City, Ky., Slaughters, Ky., Dillsboro, Ind., and Petersburg, Ind.

The $20 million project will boost the capacity of the Texas Gas system to about 1½ billion cubic feet daily. W. M. Elmer, president of the company, stated that "as a part of this expansion program the company proposes the development of a new gas storage field located in Indiana."

Michigan Wisconsin Gets FPC Approval

Michigan Wisconsin Pipe Line Company has been granted authorization by the Federal Power Commission for construction of facilities costing $20 million to expand its Laverne, Okla., system capacity by 40 MMcf of gas per day.

Michigan will lay 56 miles of 20-inch lateral line from its main line to the Laverne field in Harper County. Nine new compressor stations totaling 31,500 horsepower will be constructed, and 8,150 additional horsepower will be installed at four existing stations.

A 20-mile, 22-inch loop will connect to the Austin field storage in Michigan.

The additional gas made available will be used to serve existing customers. Michigan Wisconsin will supply its affiliate, Michigan Consolidated Gas Company, with 10 MMcf daily and deliver the remaining 30 MMcf to other customers.

Michigan is awaiting approval on other facilities connected with this project and estimated to cost $2.6 million.

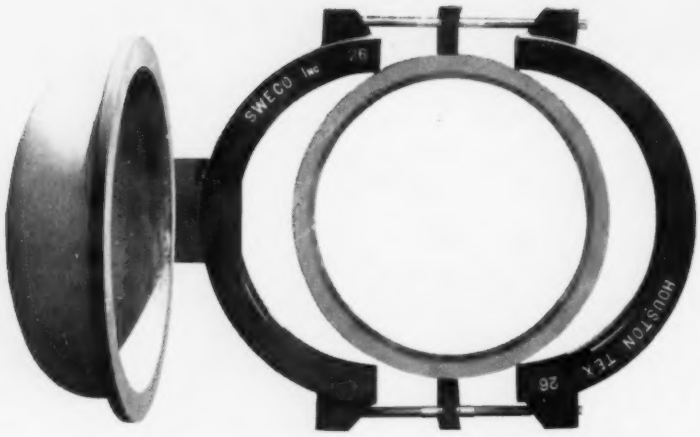
Humble Lets Contracts On Gas Gathering Lines

Humble Oil & Refining Company has let contracts on 37 miles of 24-inch and 47 miles of 12-inch gas lines near Falfurrias in southwest Texas.

H. B. Zachry Co. has the 24-inch; H. S. Shanks & Sons has the 12-inch section. Both lines will be part of Humble's King Ranch gas gathering system.

At King Ranch, Humble will gather gas from several shut-in fields and deliver it to the company's proposed cycling plant to be built near the Seeligson compressor plant in Kleberg County.

At present, Humble is constructing a 78-mile line from Clear Creek to Port Arthur which will tie in with its proposed 250 mile, 30-inch line from southwest Texas.



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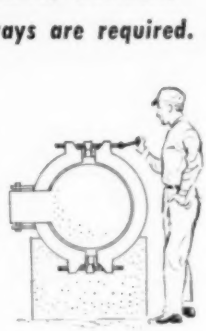

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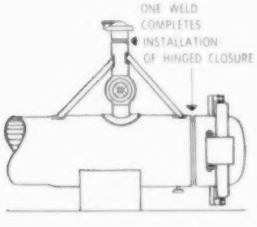

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New York State Natural Gas Lets Contracts on 83 Miles

New York State Natural Gas Corporation recently let contracts for construction of 83 miles of pipe in New York and Pennsylvania. Pipeline Maintenance & Construction will lay 12 miles of 30-inch in Tompkins, N. Y.; Hartford Brothers will construct 13 miles of 20-inch in Potter County, Penn., and 20 miles of 6- to 12-inch in the Leidy storage pool; Joyce Pipe Line Co. has 30 miles of 20-inch to be built in Erie County, N. Y.; and Felmont Oil Corp. will lay 8 miles of 6- to 12-inch in Woodhill storage project in Steuben County, N. Y.

Gulf Resources Formed To Build 125-Mile Line

A new company, Gulf Resources, has been formed to build and operate a 125-mile pipe line and gas gathering system from the Lopena area in Zapata County to a point in La Salle County, Texas.

Gulf will receive gas from the Jonnell Gas Company, which owns 60,000 acres of leases in Zapata and Starr counties.

Wabash Pipe Line Company Will Construct 265-Mile Line

The Wabash Pipe Line Company, formed by Continental Oil Company and the Ohio Oil Company, will soon let contracts on a 265-mile products line from Wood River, Ill., to East Chicago, Ind.

Wabash will operate the common carrier pipe line system which includes an 85 mile line from Robinson to Champaign, Ill. Ohio owns 75 percent of the stock and Continental 25 percent. The line will have an ultimate capacity of 90,000 to 100,000 bbl per day.

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PROPOSED PIPE LINE CONSTRUCTION

Here in convenient summary form is Pipe Line Industry's listing of company, line size, length, service, location and project status.

U. S.

Buckeye Pipe Line Company, New York. 50 miles, 10-inch, products, main line, from point north of Syracuse to Utica, N. Y., contracts let to Sheehan Pipe Line Construction Co.

Chicago District Pipeline Company, 52 miles, 30-36 inch, gas, from Natural Gas' proposed line at Joliet to Chicago, $13 million, before FPC.

Coastal States Gas Producing Co., Corpus Christi, Texas, 45-mile, gas gathering system in Bee County, Texas to connect with Texas Eastern's main pipe line, $1 million, planned.

Coastal Transmission Corp., Houston, 574 miles, 22-24 inch, gas, from McAllen, Texas to Baton Rouge, La. connection of Houston, Texas Gas and Oil plus 414 miles of laterals, $55 million, authorized.

Colorado Interstate Gas Co., Colorado Springs, 734 miles, 24-30 inch, gas, from Texas & Okla. Panhandle to Kit Carson, Colo., to Beatrice, Neb., plus four compressor stations, $87 million, before FPC.

Conn-Mass Pipe Line, Inc., Orange, Conn., 88 miles, 8 inch, products, from Boston to Springfield, Mass., considered.

133 miles, 16-inch, products, from Linden, N. J. to Hartford, Conn., considered.

62.2 miles, 8-inch, products, from New Haven, Conn. to Springfield, Mass., considered.

38 miles, 6-inch, products, from Waltham, Mass. to Fitchburg, Mass., considered.

Consumer Power Co., 15 miles, gas, main line, from Woodbury station to Laingsburg Junction, planned.

Deep Rock Gas Co., Oklahoma City, 120 miles, 6-inch, LPG, from Tioga, N. D., to Canadian border, planned.

Eastern Shore Natural Gas Company, Salisbury, Md., 124 miles, 6 and 8-inch, gas facilities on eastern shore areas of Delaware and Maryland, $3 million, authorized.

El Paso Natural Gas Company, El Paso, 216 miles, 26 to 34-inch main line, 533 miles, 6-20-inch laterals, gas, 86,750 compressor hp in Arizona, New Mexico and Texas, contracts let on 345 miles to R. H. Fulton, & Co., McVean & Barlow, Inc., and Western Pipe Line, Inc.

126 miles, 30-inch main line, 266 miles, laterals, gas, 28,920 compressor hp in new and existing stations, FPC authorization for field facilities.

511 miles, 34-inch, Twin Falls, Idaho to California border near Las Vegas, planned.

Emerald Pipe Line Corp., 300 miles, 6 inch, products, from Amarillo, Texas, to Albuquerque, N. M., contracts let to Arey Pipe & Construction Co., Inc. on 105 miles to Tucumcari, N. M.

Equitable Gas Company, Pittsburgh, Penn., development of Rhodes natural gas storage pool in Lewis County, W. Va., and construction of 11.7 miles of storage pipe line and other facilities, $2,091,430, authorized.

Everglades Pipe Line Company, Miami, Fla., 35 miles, 10-inch, products, Port Everglades to Miami International Airport, $2.5 million, planned.

Gillette Pipeline Co., Cheyenne, Wyo., 103 miles, crude, from Dead Horse Creek field to Casper, Wyo., planned.

Great Northern Railway, St. Paul, 400-600 miles, 12-20 inch, crude, from Williston Basin to St. Paul-Minneapolis and Duluth-Superior areas, considered.

Gulf Interstate Gas Co., Houston, 12.8 miles, 6 and 20 inch, gas, loop line in Louisiana, $730,000, authorized.

350 miles, 30-inch, and 55 miles, 24-inch, loop lines in Kentucky, Mississippi, Tennessee, and Louisiana, $50 million, contracts let on 350 miles to Houston Contracting Company and H. C. Price Company.

Gulf Pacific Pipe Line Company, 1,600 miles, 30-inch, gas, Louisiana to California border, considered.

Gulf Resources, New York, 125 miles, gas, gathering system, from Lopena area in Zapata County to a point in La Salle County, Texas, planned.

Harry Bass & Sons, Inc., Dallas, gas gathering lines, Pembina field, Alberta, $17 million, approved.

Humble Oil & Refining Co., 250 miles, 26 or 30 inch, gas, and 200 miles, main gathering system, line of varying sizes, from southwest Texas to Houston, plus gas processing and cycling plant near Corpus Christi, $75 million, planned.

37 miles, 24-inch and 47 miles, 12-inch, gas gathering lines, contracts let to H. B. Zachry and H. S. Shanks & Sons.

Iron Ranges Natural Gas Co., 115 miles, gas, from Itasca and St. Louis counties along route of Mesabi range from Grand Rapids to Aurora, Minn., $5 million, before FPC.

Katy and New York Central Railroads, 2500-mile, 10-12 inch, LPG, from Houston, Texas, to New York, considered.

Kerr-McGee Oil Industries, Inc., 24 miles, 4 inch, gas, to connect wells with its Breton Sound production island off the Louisiana coast, authorized.

Magna Pipeline Co., 40 miles, gas, underwater line from Anacortes, Wash., to Victoria, B. C., $6 million, planned.

Manufacturers Light and Heat Co., Pittsburgh, Penn., 13.8 miles, 10 and 12 inch, gas, facilities in Ohio and West Virginia, $757,300, authorized.

28 miles of 8, 12 and 26-inch line gas, in Ohio and Penn., planned.

Michigan Gas Storage Co., Jackson Mich., gas, facilities in central Michigan, $2 million, authorized.

Michigan Wisconsin Pipe Line Co., Detroit.

102 miles, 4- to 20-inch, gas lines to connect new gas supplies in Laverne field, Northwestern Oklahoma, authorization for a part.

25.3 miles, 12-inch, lateral loop, in Wisconsin, before FPC.

20.5 miles, 24-inch, main line loop in Michigan, before FPC.

Midwestern Gas Transmission Co., Houston, 2067 miles, 3—24-inch, gas, from Emerson, Manitoba to Portland, Tenn., $111 million, before FPC.

Mookl Chemical & Gas Corp., Tulsa, and **Missouri Transmission Corp.**, Springfield, Mo., 425 miles, 16-inch, gas, from Oklahoma City area to St. Louis, before FPC.

Natural Gas Pipe Line Co. of America, 416 miles, 36 inch, gas, loops at various points along existing line between Beatrice, Neb., and Joliet, Ill., $76.2 million, before FPC.

396 miles, 30-inch, gas, loops between company's terminus near Fritch, Texas and Joliet, Ill., $63 million, before FPC.

258 miles, 36-inch and 21 miles, 26-inch, gas, loops, between Fritch, Texas, and Beatrice, Neb.; 232 miles, 36-inch, loops, between Beatrice and Joliet, Ill. $87 million, temporary FPC authorization

North Carolina Natural Gas Corp., 630 miles, 2-16 inch, from Transco's system near Mooresville across to southeastern North Carolina, authorized.

Northern Illinois Gas Company, 140 miles, 24-inch, gas, main line, East Dubuque to Des Plaines, Ill., planned.

Northern Natural Gas Co., Omaha, 167 miles, 20 inch, gas, from Farmington, Minn. to Duluth, Minn., and Superior, Wis., $12 million, before FPC.

42 miles, 10 inch, gas, from Rochester, Minn. to Winona and Goodview, Minn., $963,000, before FPC.

365 miles, gas, new facilities in Minn., Iowa, S. D., Neb., Wis., plus 1090 miles of branch line and station facilities, $65.7 million, authorization for a part. Gas facilities in Texas, Oklahoma and Kansas, $6 million, before FPC.

454 miles, main line loops and extensions, 6-30-inch, main line from St Cloud, Minn., to Grand Forks, N. Dak., also 1,490 miles of branch lines, 2-10-inch, and station additions totaling 32,000 horsepower, $86 million, planned.

27.6 miles, 30-inch, gas, loop; 18.3 miles north of Beaver station in Okla., 9.3 miles north of Sunray station in Texas, $3 million, authorized.

Northern Utilities Co., 35 miles, 16 inch, gas, in Fremont Natrona County, Wyo., area; 8 miles, 12 inch, around Casper; 6 miles, 8 inch, from Sand Draw gas field to Beaver Creek field; 12 miles, 6 inch, from Beaver Creek field to the system servicing the Riverton-Lander area, planned.

"Bimetal Freeze-up" Can Be More Serious Than Dial Fogging Problem

The first sign of moisture in a dial thermometer usually shows up as condensation inside the dial glass. You are probably familiar with this dial fogging problem which causes difficult reading and the eventual corrosion of the bimetallic element. You may not, however, be familiar with another and actually more serious moisture problem —bimetal "freeze-up."

Both dial fogging and bimetal freeze-up are permanently prevented by RMC's dry air hermetic sealing process.

If moisture is sealed in, or enters a thermometer dial it will find its way to the bimetal element. Then at extreme low temperatures this moisture freezes on the element and bearing surfaces, and the bimetal element will not function should the temperature go lower. Therefore, the operator of the equipment would never know that the temperature had gone below the last indication when the element became frozen.

Here's what makes such a condition hard to spot. The thermometer would operate properly again after a temperature rise of perhaps 20°, and would continue accurate indication even though the fluid dropped again to an even lower temperature than before. However, after it remained at the new low for a few hours, it would again freeze up. Then, as before, any further drop in temperature would not be indicated.

Only a dry-air hermetic seal, as used by RMC, can prevent both dial fogging and bimetal freeze-up. RMC even goes a step further by providing for recalibration at any time without breaking the air-tight seal. An external dial reset screw—exclusive with RMC—permits recalibration without opening the instrument in any way.

Industrial Needs Call For Magnetic Liquid Level Gauge

Magnetic drive provides accurate readings with complete safety in all types of liquids under pressure. RMC Magnetic Level Gauges meet requirements of the Underwriters' Laboratories and A.S.M.E. Boiler Code.

Write, wire or phone—tell us your requirements for indicating instruments, and let RMC engineering skill provide the answers. Rochester Mfg. Co., 207 Rockwood St., Rochester 10, N. Y.

These RMC thermometers have just been submerged in water for 15 minutes—the first of a series of severe tests given RMC thermometers to make sure hermetic seal is perfect.

We make certain that moisture will never bother your RMC thermometer

The RMC hermetic sealing process makes absolutely certain that humid air will not be sealed in the instrument and locks all moisture out permanently. Each thermometer then goes through a series of severe tests. Only those with perfect sealing are accepted for delivery. When you order from RMC you get the *only* industrial thermometer that can *never* be affected by internal dial fogging or bimetal freeze-up.

RMC

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Ohio Fuel Gas Co., 51 miles, gas, main lines, in Belmont, Carroll, Cuyahoga, Fairfield, Logan, Lorain, Marion, Muskingun, Stark and Wayne counties, Ohio, $2.2 million, authorized.

Natural gas storage field in Medina County, Ohio, 12 miles, 4½ to 20-inch, gas, $5 millilon, temporary FPC authorization.

Pacific Gas & Electric Co., 1300 miles, gas, from Alberta, Canada to Antioch, Calif., $380 million, planned.

Pacific Lighting Gas Supply Co., 128-mile, 34-inch, gas, main line from Topock, Ariz. to Newberry, Calif., planned.

Pacific Northwest Pipeline Corp., Salt Lake City, 235 miles gas, gathering lines in San Juan Basin, Garmesa, Piceance Creek, and Big Piney Fields, $13.5 million, planned.

65 miles, gas, sales laterals in Washington, $1.5 million, planned.

52 miles, 30-inch loop Big Piney, Wyoming, gathering system, $5 million, planned.

123-mile, 30-inch, gas, Spokane to Kingsgate, Wash., planned.

Pennsylvania Gas Co., Warren, Penn., 38 miles, 8 and 10 inch, gas, in Erie and Warren Counties, Penn., and Chautauqua County, N. Y., $2.6 million, authorized.

Permian Basin Pipeline Co., Omaha, Neb., 26.8 miles, 10 inch, gas, from a point on existing system in Pecos County, Texas, to a gasoline plant, $787,100, authorization.

Piedmont Gas Co., Hickory, N. C., 78 miles, 2-8 inch, gas, from connection with Transcontinental Gas Pipe Line to serve customers in North Carolina, $2.6 million, authorized.

Phillips Petroleum Co., 25 miles, 6 to 20-inch, gas, South Eunice, New Mexico area, planned.

52 miles, 4 to 20-inch, gas, Gaines County, Texas, planned.

44-mile, 6-inch, products line, from Rocky pump stations to Amarillo, Texas, planned.

Plantation Pipe Line Company, 48-mile, 4-inch, products, between Bremen and LaGrange, Ga., $1 million planned.

Service Pipe Line Company, Casper, Wyo., 47 miles, 12-inch, crude, Johnson and Natrona counties, contracts let to O. R. Burden.

4,000 compressor hp at Herndon, Kans., 2,000 compressor hp at Scranton, Kans., and 2,000 compressor hp at LaGrange, Wyo.; additional 2,000 hp at Laton station, Rocks County, Kans., 2,200 additional hp at Elk Basin, Kirby, Owl Creek, and Lost Cabin stations, north of Casper, Wyo., planned.

Shell Pipe Line Corp., Houston, 100 miles, 18-20 inch, crude, Southwest Pass to Norco Refinery near New Orleans, $10 million planned.

Southern Kansas Pipe Line Co., Inc., Arkansas City, Kansas, 200 miles, 6-10 inch, crude, southwestern Kansas to Arkansas City, Kansas, planned.

Southern Natural Gas Company, Birmingham, 136 miles, 24 and 26 inch; 215 miles, various diameter supply lines; 3,650 additional compressor horsepower to White Castle and Toca Stations; 8 miles, 20-inch loops; 660 hp Franklinton station, and 23 measuring stations. $40 million, authorized.

458 miles, 16-24-inch, loop lines, gas, between Gwinville, Miss., and Wrens, Ga.; 62 miles, 14-inch, loops, along Atlanta-Macon line; 53 miles, 6⅝ to 14-inch, loops, along various branch lines. 3,140 additional hp at Gallion and Elmore, Ala. and Wrens, Ga. 60 miles, 20-inch, loops, in Louisiana between Franklinton and White Castle and South of Toca. Lateral lines south of Gwinville and west to Cranfield field. 8,720 hp added at Franklinton, White Castle, Patterson and Brookhaven. $65 million, before FPC.

Tennessee Gas Transmission Co., Houston, 556 miles, 30-inch, gas, Louisiana Delta to Portland, Tenn., contracts let to Houston Contracting Co., 38-miles; Oklahoma Contracting Co., 90 miles; Sharman, Allen, Gay & Taylor, 28 miles; Bechtel Corp., 72 miles; Panama, Inc., 117 miles; Western Pipe Line, Inc., 80 miles; and Collins Construction Co., Mississippi River crossing. Other contractors include Grayco Construction Co., and Western Construction Co.

76 miles, 24-inch, Coudersport, Penn., to Hamburg, N.Y., contract let to Williams Brothers.

264 miles loop lines in Tennessee, Kentucky, West Virginia and Pennsylvania. FPC Examiner authorization.

Compressor stations in Mississippi, Tennessee, New York, Pennsylvania and additions in Tennessee, Kentucky, Ohio and Pennsylvania, $129 million, temporary FPC Examiner authorization.

21 miles, 16-inch, 2 miles, 12¾-inch, gas, Louisiana coast, Vermillion, Blocks 46 and 64, $2.9 million, before FPC.

Texas Eastern-Penn-Jersey Transmission Corp., Shreveport, La., 65 miles, gas, from Delmont, Penn., to Lambertville, N. J., before FPC.

24,000 compressor hp additions to existing stations, $4.4 million, temporary FPC authorization.

4,000 horsepower to its Delmont, Penn., compressor station, five new compressor stations in Pennsylvania with total capacity of 67,000 hp, $11.2 million, authorized.

Texas Eastern Transmission Corp., Shreveport, La., 267 miles, 14-30 inch, gas, Louisiana, Mississippi, Pennsylvania and New Jersey, $50 million, before FPC.

59 miles, 30-inch, gas, loop additions to pipe line from Kosciusko, Miss. to Uniontown, Penn., $5.8 million contracts let to H. C. Price Co.

96.5 miles, 30-inch, gas, between Kosciusko, Miss., and Uniontown, Penn.; 9.4 miles of supply laterals; a 10,250 hp compressor station, and 33,360 hp to existing compressor stations, $24.5 million, authorized.

141,780 additional horsepower in existing stations, a new 2,200 hp compressor station, in Louisiana, Mississippi, Pennsylvania, Ohio, Kentucky and Tennessee, authorized.

Texas Eastern Transmission Corporation and Wilcox Trend Gathering System, Inc., gas, compressor stations, $4 million, authorized.

Texas Gas Gathering Corp., Shreveport, 36.6 miles, gas, gathering system in Rodney Field, Jefferson County, Miss. and from North and South Locust Ridge, Lake St. John Field in Tensas and Concordia parishes, La., $855,413, before FPC.

Texas Gas Transmission Corporation, Owensboro, Ky., 92 miles, 30-inch, 19 miles, 26-inch, and 15 miles, small diameter, loop portions of system in Louisiana, Arkansas, Mississippi, Kentucky, Indiana and Illinois; additional horsepower at Pineville, La., Kenton, Tenn., Calvert City, Ky., Slaughters, Ky. Dillsboro, Ind., and Petersburg, Ind., totaling 9,040 hp. $20 million, before FPC.

Texas Illinois Gas Pipeline Company, Chicago, 16,000 additional hp to stations at Lufkin, and Marshall, Texas; Texarkana, Malvern, Searcy, and Biggers, Ark.; Jackson, Mo.; and Hammond, Ill., $3.9 million, before FPC.

Transcontinental Gas Pipe Line Corp., Houston, 204 miles, 36-inch, 107 miles, 30-inch, main line loops in 10 states; 3 intermediate stations: North Carolina, Virginia, Pennsylvania; 2,500 additional hp at six compressor stations; 164 miles, 24-inch from Leidy storage Penn. 29 miles, 30-inch, New Jersey; gathering lines, Louisiana, 119 miles; 10 meter stations; additions to West Cameron and High Island area, 35-miles, 16-inch, 26 miles, 10-inch, and three gathering meter stations; 45 miles, 16-inch, purchase laterals and 5 meter stations, Louisiana; 67 miles, 10, 12, 20-inch miscellaneous transmission purchase laterals in Texas and Louisiana, 3 meter stations; 51 miles, 36-inch and 1 mile, 30-inch in New Jersey; 51 miles, 10- and 14-inch and 3 meter stations, southeast Louisiana (mainly offshore), $137.3 million before FPC.

151 miles, 24-inch, 12 meter stations, southeast Louisiana, $14.5 million before FPC.

2,500 additional hp at four compressor stations, St. Francisville, La.; Laurel, Miss.; Linden, Ala. and Wadley, Ala., $3 million before FPC.

Wells, pipe lines, measuring equipment, stations at Leidy storage in Pennsylvania, $12.5 million before FPC.

Trans-Utah Pipeline, 16-inch, gas, main line from Uinta Basin to Salt Lake City, considered.

Transwestern Pipeline Company, Houston, 1,305 miles, 24- and 30-inch, gas, main line, from West Texas and Oklahoma-Texas Panhandle area to Topock, Ariz., $193 million, before FPC.

Underground Storage & Exploration, Upper Darby, Penn., 394 miles, 12-inch LPG, from Moundsville, W. Va. to Newark, N. J., $9 million, approved.

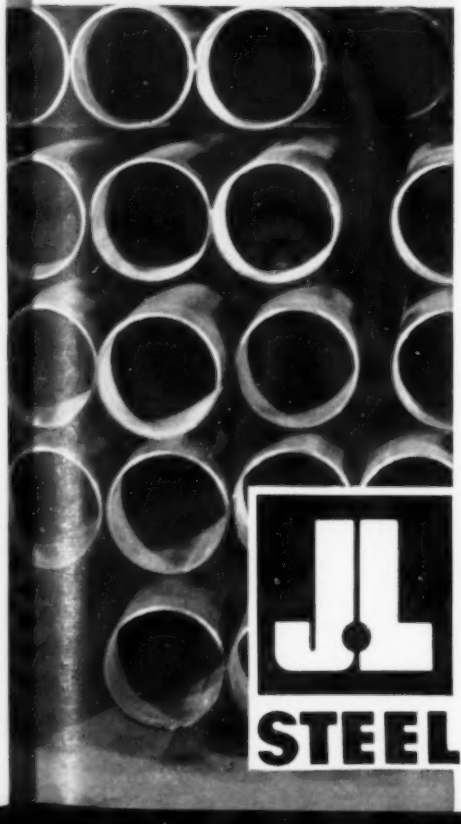
95 miles, 6-8 inch, laterals to Mauch Chunk, Penn., and to Philadelphia, planned.

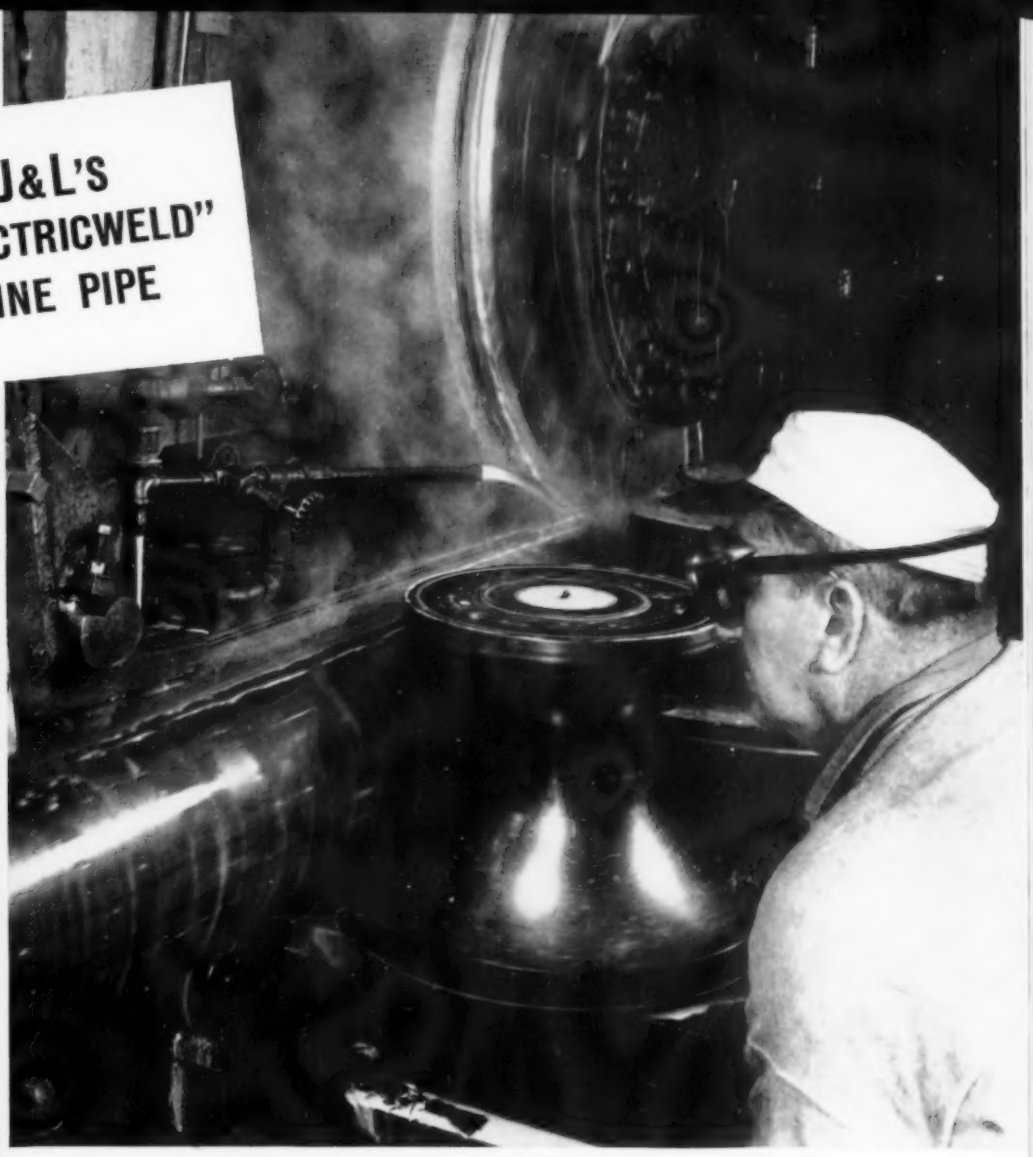
United Gas Pipe Line Co., Shreveport, La., 203 miles, 30-inch, gas, between New Orleans and Mobile, Ala., $33.7 million, authorized.

Wabash Pipe Line Company, 265-mile, 12-inch, products, Wood River, Ill., to East Chicago, planned.

International

ACT Oils, Ltd., Montreal, 400 miles, crude, Dawson Creek, B. C., to Bella





J&L'S "ELECTRICWELD" LINE PIPE

"EVERY LENGTH QUADRUPLE-TESTED FOR UTMOST DEPENDABILITY"

Rigid quality control has top priority in production of J&L's Electricweld pipe for gathering, distribution and transmission lines.

Every length is pressure-tested under the specified A.P.I. or A.S.T.M. hydrostatic test requirement both in time and in degree of pressure. Lengths to 60 feet speed installation, reduce number of field welds.

Electricweld pipe is available from 6⅝ inches through 12¾ inches O.D. Electricweld line pipe is manufactured to appropriate A.P.I. and A.S.T.M. specifications.

In addition to **visual inspections,** each length of pipe is given a **crush test,** to determine weld strength and quality of steel. It is subjected to a pressure test on one of the largest and most modern **hydrostatic testers** in the world. As an additional precaution and assurance to the customer, Jones & Laughlin is giving both ends of each joint a **magnaflux examination.**

Get complete information on Electricweld line pipe from your J&L distributor or write direct to Jones & Laughlin, 3 Gateway Center, Pittsburgh 30, Pa.

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PITTSBURGH, PENNSYLVANIA

J&L STEEL

Coola, B. C., before B. C. government.

Alaska-Yukon Refiners and Distributors, Ltd., Edmonton, Alta., 150 miles, products, serving Alaska and Yukon territory, $3.5 million, planned.

Bituminous Oil Pipeline Co., Calgary, 250 miles, crude, from Athabasca tar sand plant in northeastern Alberta to Edmonton, approved.

Williams-McWilliams Industries, Inc., New York, 441 miles, 6-inch, crude, Villa Montes, Bolivia to Villa Hayes, Paraguay, considered.

British Petroleum Co., 60 miles, crude, from deep water tanker terminal at Milford Haven, U. K. to Llandarcy Refinery, $18 million, planned.

Burmah Oil Co., Ltd., 850 miles, crude, 20 inch, from Nahorkatiya to Calcutta, India, planned.

Consolidated Gathering Systems, Ltd., Calgary, 198 miles, crude, Sturgeon field to Edmonton, planned.

Cuban Gas Transmission Co., 650 miles, gas, from Campeche area of Mexico across Yucatan and under Gulf of Mexico to Havana, Cuba, 120 miles would be submarine, considered.

Development and Resources Corp., 70 miles, 8 inch, gas, from Agha Jari oil field to Ahwaz, Iran, planned.

East Coast Transmission Co. (Pacific Petroleums, Ltd., Home Oil, Ltd., Canadian Homestead Oil, Ltd. and Merrill Petroleums, Ltd.), crude, from Alberta to Toronto, considered.

Elburz Oil Corp., 1000 miles, crude, from Central Iran to Alexandretta, Turkey $450 million, planned.

Entre Nazionali Idrocarburi, Rome, Italy crude, from Qum field in Iran to the Mediterranean Sea, considered.

Federated Pipelines, Ltd., 125 miles 10¾-inch, crude, main line, from Swan Hills area of Northern Alberta to Edmonton, approved.

Hydrocarbons Pipeline, Ltd., Winnipeg Manitoba, 880 miles, 6-8 inch, products from Edmonton to Winnipeg, $35 million, partial authorization.

Interprovincial Pipe Line Company, 350 mile extension from Toronto to Montreal, looping line from Edmonton to Toronto, crude, $240 million, considered.

Iraq Joint Venture Pipe Line, 1200 miles, 38-40 inch, crude, from head of Persian Gulf through Iraq to Turkish coast of Mediterranean, $840 million, planned.

Mid-Continent Pipe Lines, Ltd., 1500-mile, 30-inch crude, Edmonton to Chicago, planned.

National Iranian Oil Co., 146 miles, 6 inch, crude, from Azna to Isfahan, Iran, $5 million, planned.

1000 miles, 38 inch, crude, from central Iran to the Turkish Mediterranean coast, considered.

Rotterdam-Rhine Pipeline Co., 185 miles, 28-inch, crude, from Rotterdam to Wesseling, Germany, preliminary work under way. Bechtel Corp. is prime contractor.

Peace River Oil Pipe Line Co., Ltd., 70-mile, crude, Swan Hills to Iosegun Junction, approved.

Petroleos Mexicanos, 108 miles, 10 inch, gas, from Gral. Escobedo to Monclova to tie into Reynosa-Monterrey gas pipe line, $9 million, planned.

600 miles, 24 inch, gas, from Pemex City to Mexico City, $50 million, planned.

38 miles, 4 inch, products, from Mexico City to Toluca, $500,000 planned.

126 miles, 4, 6 and 8 inch, products, from Mexico City to Cuernavaca and Puebla, $2.5 million, planned.

Sui Gas Transmission Co., Multan, Punjab, India, 145 miles, 8-inch, gas, from Sylhet to Dacca, East Pakistan, $9 million, considered.

130 miles, 16-inch, gas, main line, Multan to Lyallpur, planned.

Trans-Europe Pipe Line, 700 miles, 30 inch, main trunk, crude, from Mediterranean to northern Europe, considered.

Westcoast Transmission Company, Ltd., 174 miles, 30-inch, gas, Savanna Creek gas field, Alberta, to British Columbian border, $45 million, planned.

650 miles, crude, from Peace River area to Vancouver, $100 million, planned.

Yacimientos Petroliferos Fiscales, Buenos Aires, Argentina, 621 miles, 12-inch, products, Mendoza to San Lorenzo, Argentina, $19 million, planned.

281 miles, 12¾ inch, crude, Pichanal to San Miguel Tucuman to Techint, S. A., planned.

450 miles, 16-inch, crude, from Neuquen Province to Bahia Blanca, planned.

GAS FOR
WESTCOAST TRANSMISSION
COMPANY LIMITED
KEPT CLEAN BY
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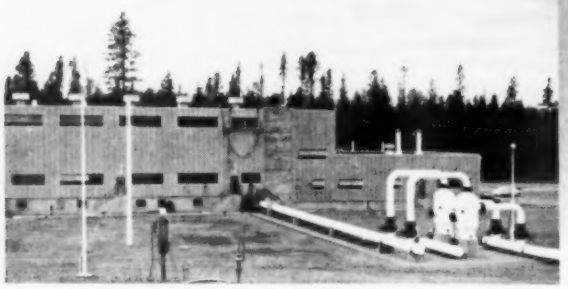

AEROTEC

From the gas-rich Peace River fields in Canada, an abundance of gas now flows to Southern British Columbia and the Northwest United States. Snaking its way over mountains, valleys and across streams it winds 650 miles to the Washington border.

Pumping gas over this tortuous route requires compressor stations,one of which is illustrated above. Here Aerotec Gas Scrubbers protect the compressors and metering stations by removing solid and liquid impurities. Each installation is capable of handling 530,000,000 SCFD at 600 psig and a pressure drop of 2 psi. They are a fraction of the size of other conventional scrubbers.

Aerotec Gas Scrubbers are serving practically every major gas line in the United States, South America and other parts of the world.

Contact our Project Engineers for further information on cleaning gas the DRY way.

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Provides maximum work per operating dollar—Allis-Chalmers engines give you real *Do-More Power* — with high torque, efficient combustion that squeezes the last bit of energy from every bit of fuel.

Keeps working day after day—There is unusual performance in rugged Allis-Chalmers engines — there is less wear, less that can go wrong.

Gets back to work faster — Design simplicity means easier servicing, too. Allis-Chalmers diesel engines are back to work quickly because you are close to fast parts and service, wherever you are.

See your Allis-Chalmers dealer for full information on engines that save you money, 9 to 516 hp, any fuel, any application. Allis-Chalmers, Milwaukee 1, Wisconsin.

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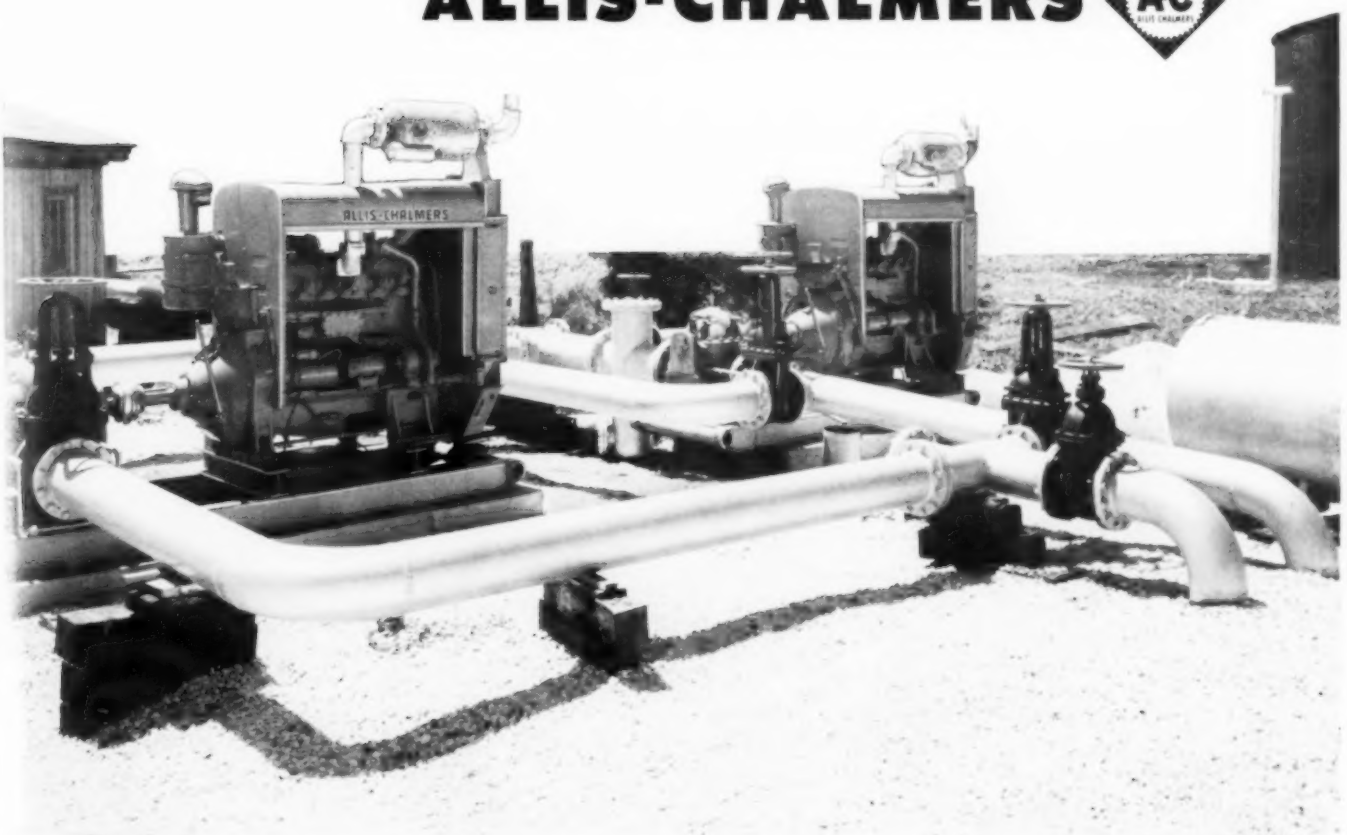
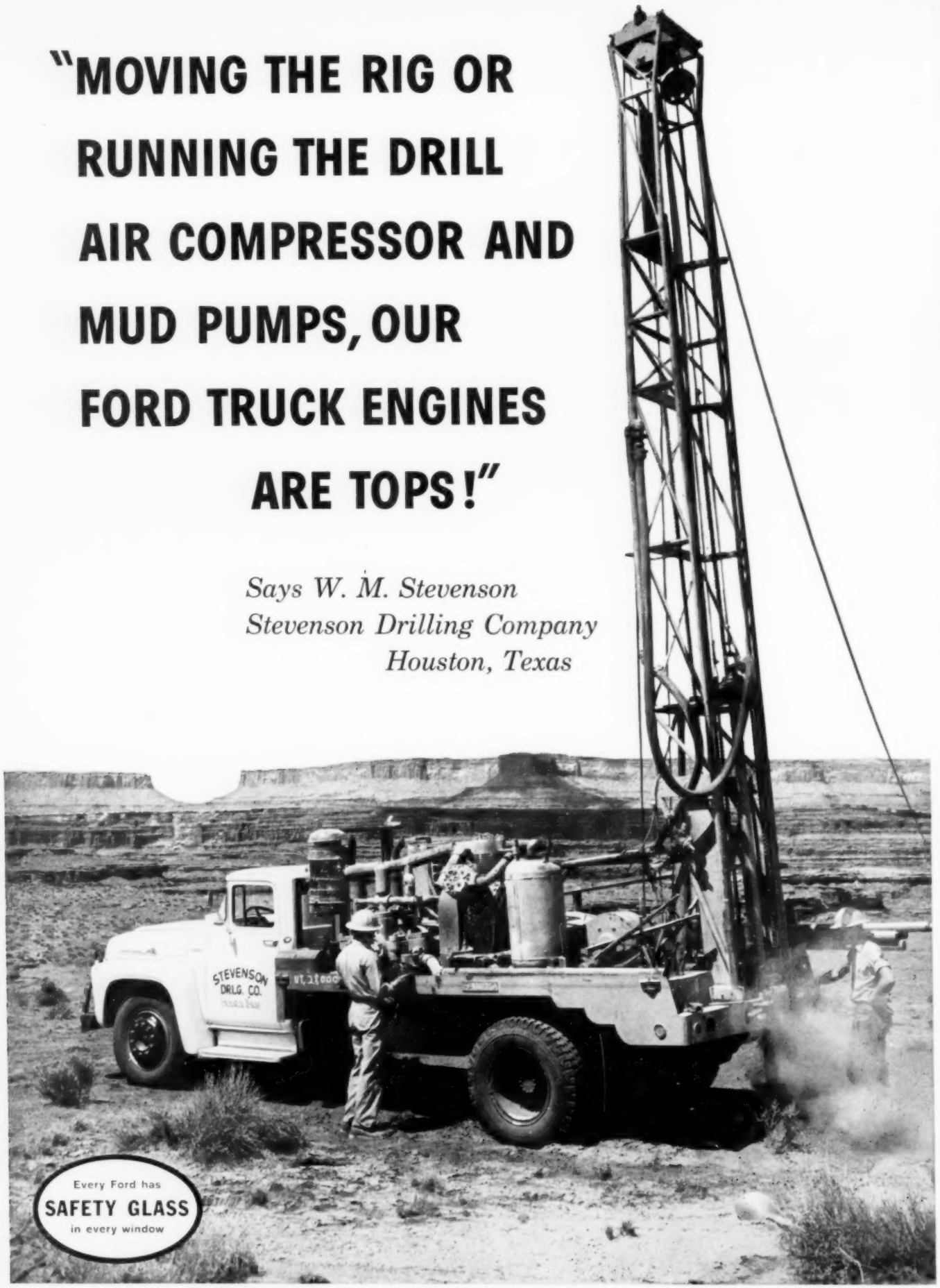


Two Allis-Chalmers 779 diesel engines pumping crude oil from storage tanks into tankers at the Westwago terminal for the American Liberty Marketing Co., New Orleans.

BC-17

"MOVING THE RIG OR RUNNING THE DRILL AIR COMPRESSOR AND MUD PUMPS, OUR FORD TRUCK ENGINES ARE TOPS!"

Says W. M. Stevenson
Stevenson Drilling Company
Houston, Texas



Official 1957 registrations show ***AMERICAN BUSINESS BUYS MORE FORD TRUCKS THAN ANY OTHER MAKE!***

"We normally run truck engines on LP-Gas while drilling, but our Super Duty V-8 is proving so economical we don't plan to convert it

"Our newest Ford is a '58 Extra Heavy with 401-cu. in. Super Duty V-8 engine. This unit utilizes a transmission power take-off to operate the drill. We can drill down to 1,500 feet with this unit, although normally we go 100 to 150 feet for shot-hole work. Explosives are then planted and seismographic studies made of the area.

"Getting to the job over difficult terrain in the Rockies is only the beginning for us. The truck engine must power the combination air or water drill 8 hours a day. We operate 5 combination drill rigs and 2 water drills, along with supply trucks (like the pickup with 5-man cab shown above) and two-ton water tank trucks.

"We've used Ford trucks since 1946 . . . it's proved very economical for us. Our repair costs have been low, thanks to Ford durability. Also, Ford replacement parts are available most everywhere, and cost much less than parts for other makes we've owned."

Bring extra savings to your business . . . make your next truck a FORD!

Ford trucks are your best buy! Ford's initial costs are *low* and resale value is traditionally high. The modern Ford Styleside pickups are the lowest-priced models available with full cab-wide body . . . giving you 23% more loadspace than any traditional pickup box.

Ford Tilt Cab trucks offer exceptional payloads, maneuverability, service accessibility and driving ease . . . they're the most popular tilt-cab line, *by over two to one!*

Only Ford offers the economy of Short Stroke power in all engines, Six or V-8. And Ford's Heavy Duty V-8's offer new, advanced durability features. The modern Ford Six has a new carburetor that gives up to 10% greater gas mileage. It's plenty peppy, too, with more horsepower per cubic inch than any other six in its class.

Ford's rugged cab and chassis construction means these new '58s are built to last. All this plus the proven fact that Ford trucks last longer adds up to America's No. 1 truck value. See your local Ford Dealer for the latest in '58 trucks or the best in A-1 used trucks.

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. . . LESS TO OWN
. . . LESS TO RUN
. . . LAST LONGER, TOO!

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How to do it

PIPE LINE HINTS

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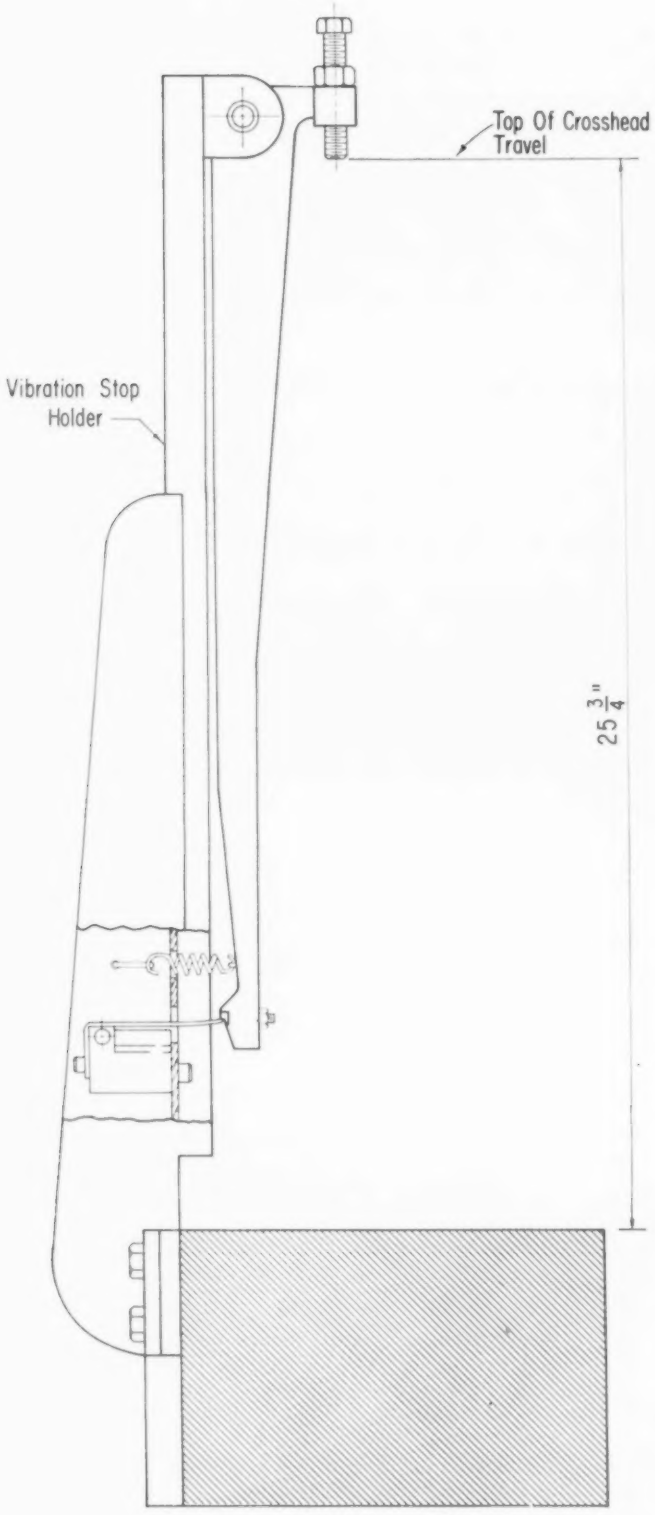
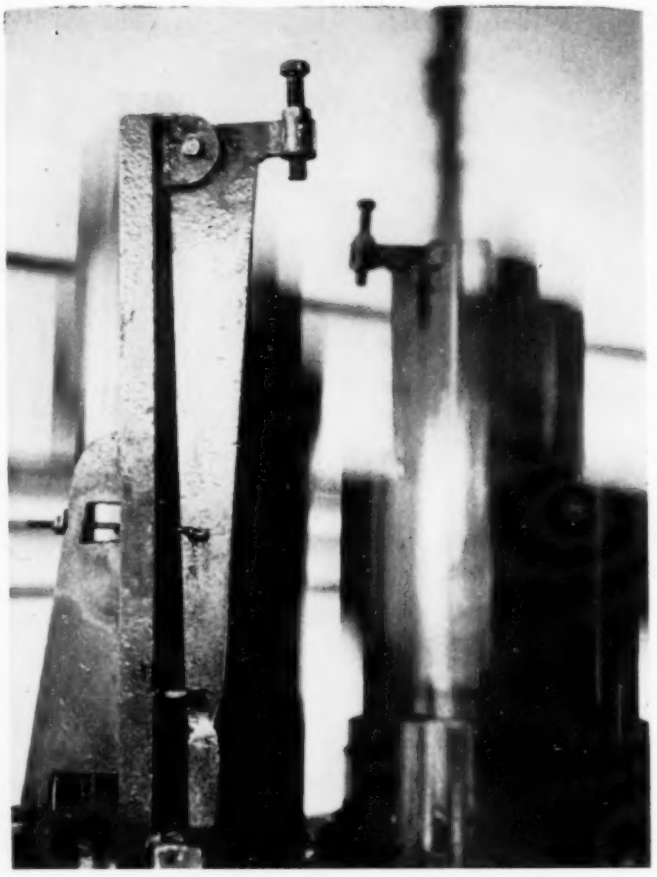


Schematic of safety stop on pump crosshead which shuts down engine in case of pump bearing or rod failure.



Action photo shows safety stop on operating pump.

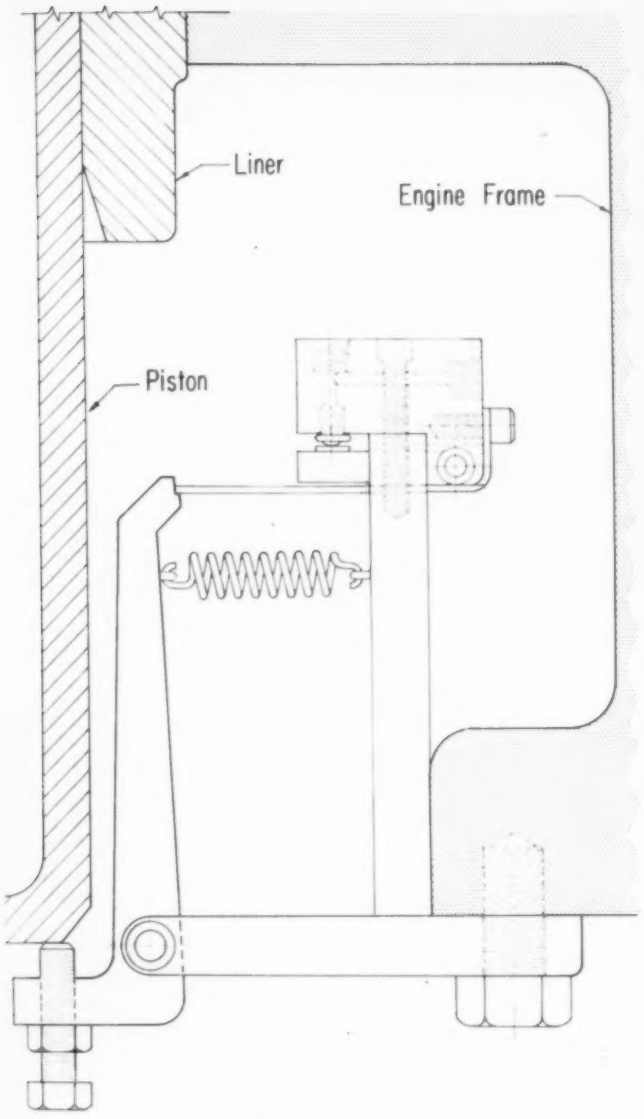
Automatic Shutdown

Automatic shutdown of the engine in case of bearing or rod failure in the pump is possible when this device is installed on the pump.

The trip lever and holder are mounted on top of the pump in such a way that the bolt tip is directly above the top limit of crosshead travel. The gap between crosshead and bolt tip is generally 0.006 inch.

In the event of a bearing or rod failure in the pump, the additional travel of the crosshead moves the bolt and lever. A spring at the bottom of the lever actuates an air pressure spill valve which bleeds air from the air-safety system on the engine and automatically shuts the engine down.

The same device has been used to spill the lube oil pressure to the low lube oil pressure shutdown device on the engine, but the use of air has proved faster and more reliable.



Engine Bearing Failure Safety Stop

Protects Engine

A similar device was built for use on certain types of diesel engines where there was not sufficient room in the crankcase to install a standard "watchdog" system beneath each connecting rod bearing.

It consists of a trip lever to the bottom of which is attached an adjustable bolt. The top of the lever engages a spring which is connected with an air pressure spill valve.

The lever and bolt are mounted so that the bolt tip is immediately below the lower limit of piston travel. The gap between piston and bolt tip is generally set at 0.006 inch.

In the event of bearing or rod failure in the engine, the consequent drop of the piston below its normal limit of travel moves the bolt and lever, releasing the spring which in turn bleeds air from the air-safety system on the engine and automatically shuts down the engine.

Tire Cage Protects Operator

A cage type tire holder—which prevents injuries caused by rims of large tires flying off while being inflated—has been put into use at a company garage.

The cage is made large enough to accommodate 1100 by 20 size tires. Steel bars of the cage fit tightly against the tire, leaving no slack or room for the rim to fly off under pressure and injure the operator.

Fabricated steel floor plate was used to construct the back, top and closed side of the cage. Front of the cage is made from ½-inch pipe with round iron $^{3}/_{16}$-inch horizontal braces. Vertical ½-inch pipe is set on 6½-inch centers. The entire cage, which is 45 inches high, and 45 inches wide with a depth of 14½ inches outside and 13 inches inside, is welded construction.

Make Fire Extinguisher Rack

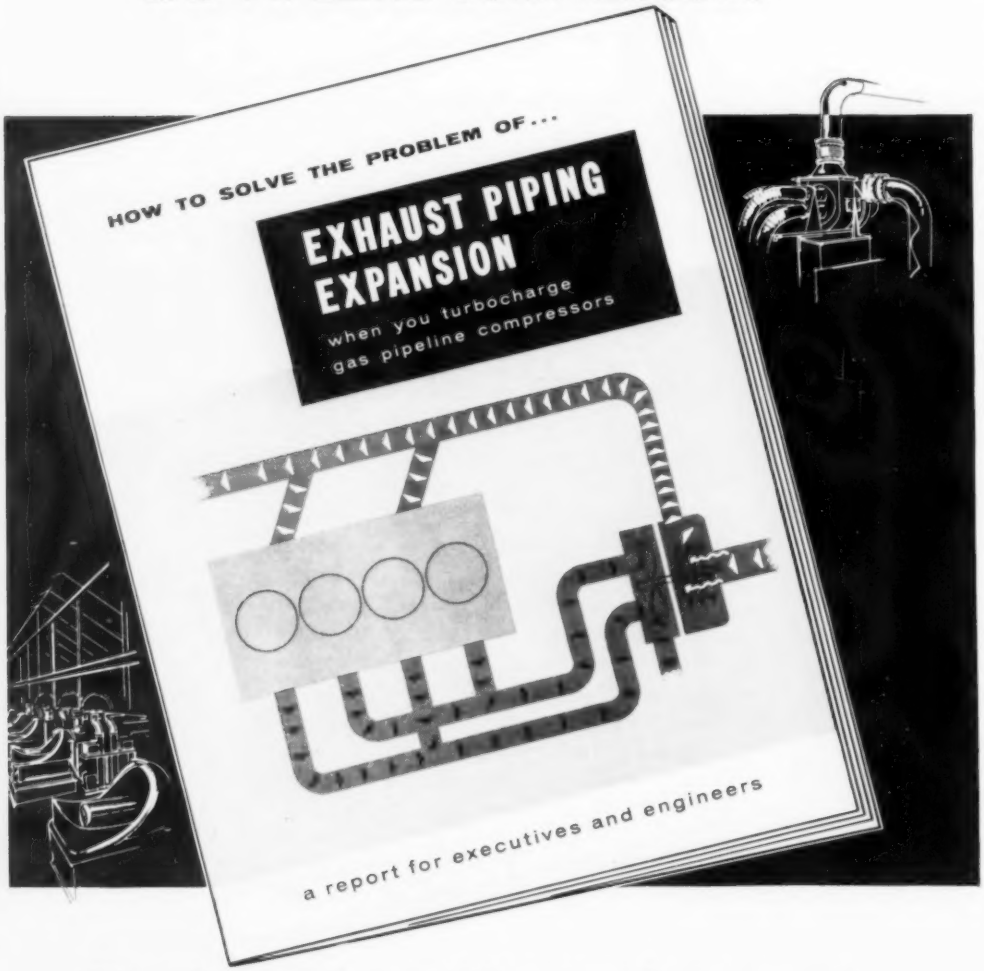
A neat storage rack can be installed easily for two fire extinguishers near station manifold and main line pumps.

The rack is made from a small diameter pipe which rises about 4 feet above the ground. The fire extinguishers fit in small steel extensions welded on the pipe near the bottom, and clips are bolted near the top of the pipe to secure the extinguishers.

answer to the problem of

EXHAUST PIPING EXPANSION

WHEN TURBOCHARGING GAS PIPELINE COMPRESSORS


HOW TO SOLVE THE PROBLEM OF...
EXHAUST PIPING EXPANSION
when you turbocharge gas pipeline compressors
a report for executives and engineers

Write today for your free copy of this easy-to-read report on a most important and lively topic—*increasing gas pipeline capacity by turbocharging existing compressors in the field*. The report tells you the dollars-and-cents facts that led an important gas pipeline company to a complete turbocharging program.

And it also tells about the apparently insurmountable problems of expansion and vibration that arose when the exhaust piping became an integral part of the operating loop—and how the company's engineers, with the help of expansion joint experts from Flexonics, were able to solve the problems.

Whether or not you are considering a field turbocharging program, you'll want to know how three years of close cooperation developed a solution that is both simple and logical—a typical Flexon result. Send for your copy of the report, today.

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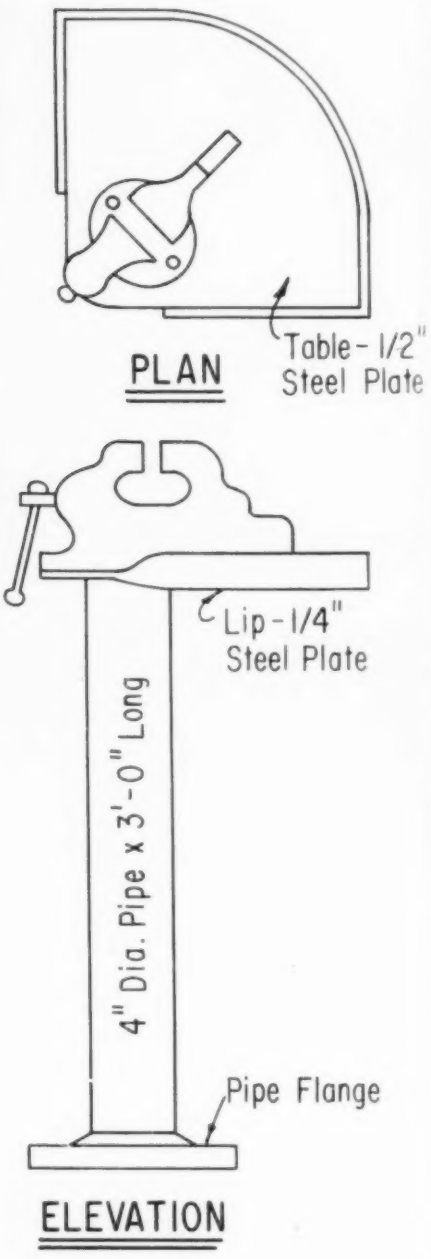
Vise Stand Gets Mechanic Away From Crowded Bench

A vise stand can be made for your shop by using an old pipe flange for the base plate to which is welded a 36-inch piece of four-inch pipe. The vise table is made from ½-inch steel plate to which is welded a lip formed with one-quarter steel plate and welded to the table.

The stand provides a convenient method for using a vise away from a cluttered workbench and also gives the mechanic a place to lay his tools and parts while he is using the vise.



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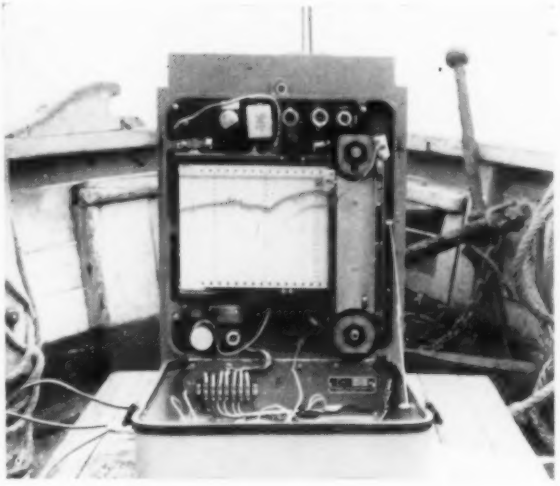

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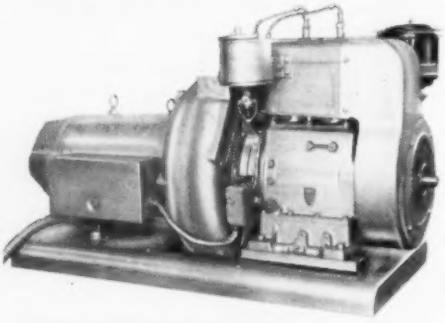

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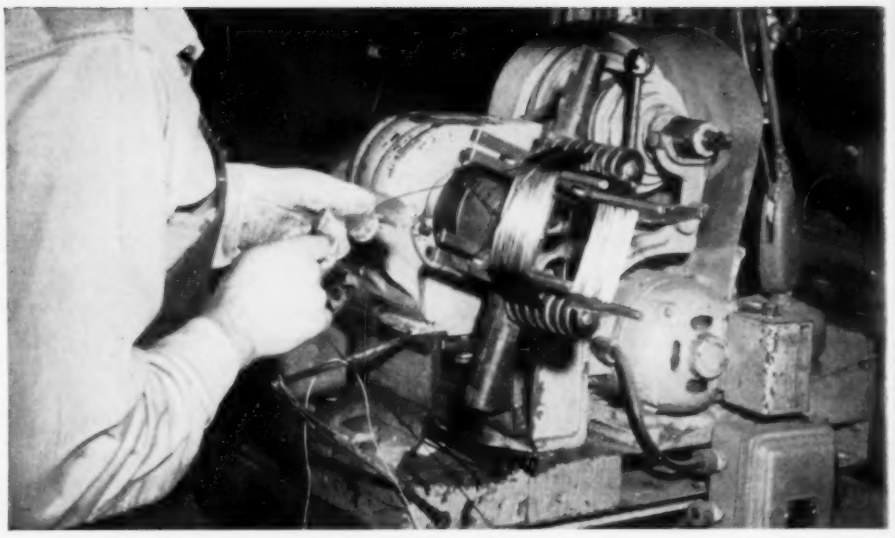
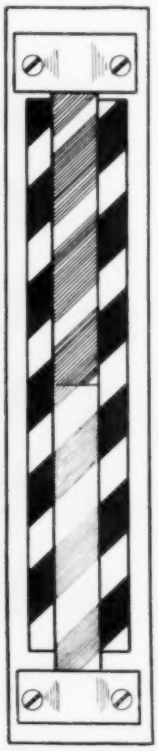


Make Motor Coil Rewinding Machine Out Of Old Lathe

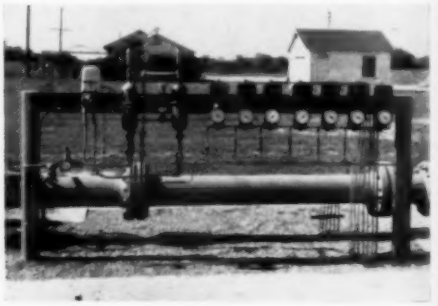
A motor-driven, coil winding machine was made from a discarded lathe at The Dow Chemical Company's Freeport plant. The old lathe bed was sawed-off, leaving the motor and gearing; the adjustable coil winder was placed in the chuck. The reduced speed makes the winding operation slow enough to perform a good job on rewinding small motors.

An ordinary fluorescent desk lamp, attached to the back of the lathe, provides the electrician with extra light to guide the wire in the rewinding procedure.



Mount Panel Of Alternate Stripes Behind Gage Glass

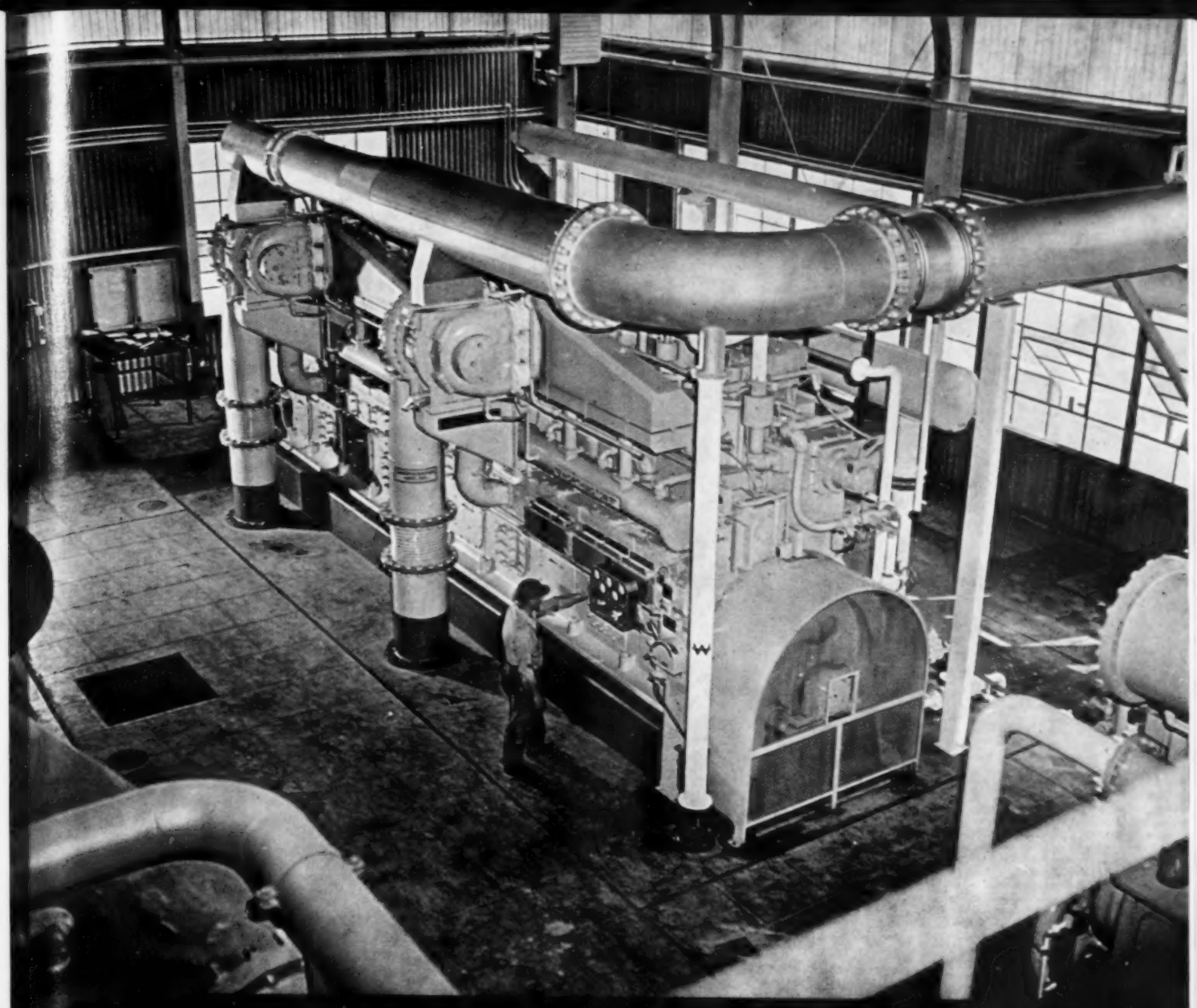
When receivers, boilers and storage tanks have gage glasses attached, operators seem to have difficulty seeing the level of the liquid in the glass. To offset this difficulty, try mounting a panel of black and white alternate stripes behind the glass. This will show where the level is because the stripes behind liquid appear distorted. If the liquid is dark, the stripes will show the level just as readily. The stripes should be running at 45 degrees to the glass.



Build Rack for Mounting Transmitters and Gages

An efficient rack can be constructed for mounting all pneumatic transmitters and gages for remote reading instruments in a pump station.

The rack can be made of old 4-inch pipe and pieces of channel iron as shown above. Copper lines go to various pressure or flow points, and to the pneumatic receivers and recorders inside the pump house office.



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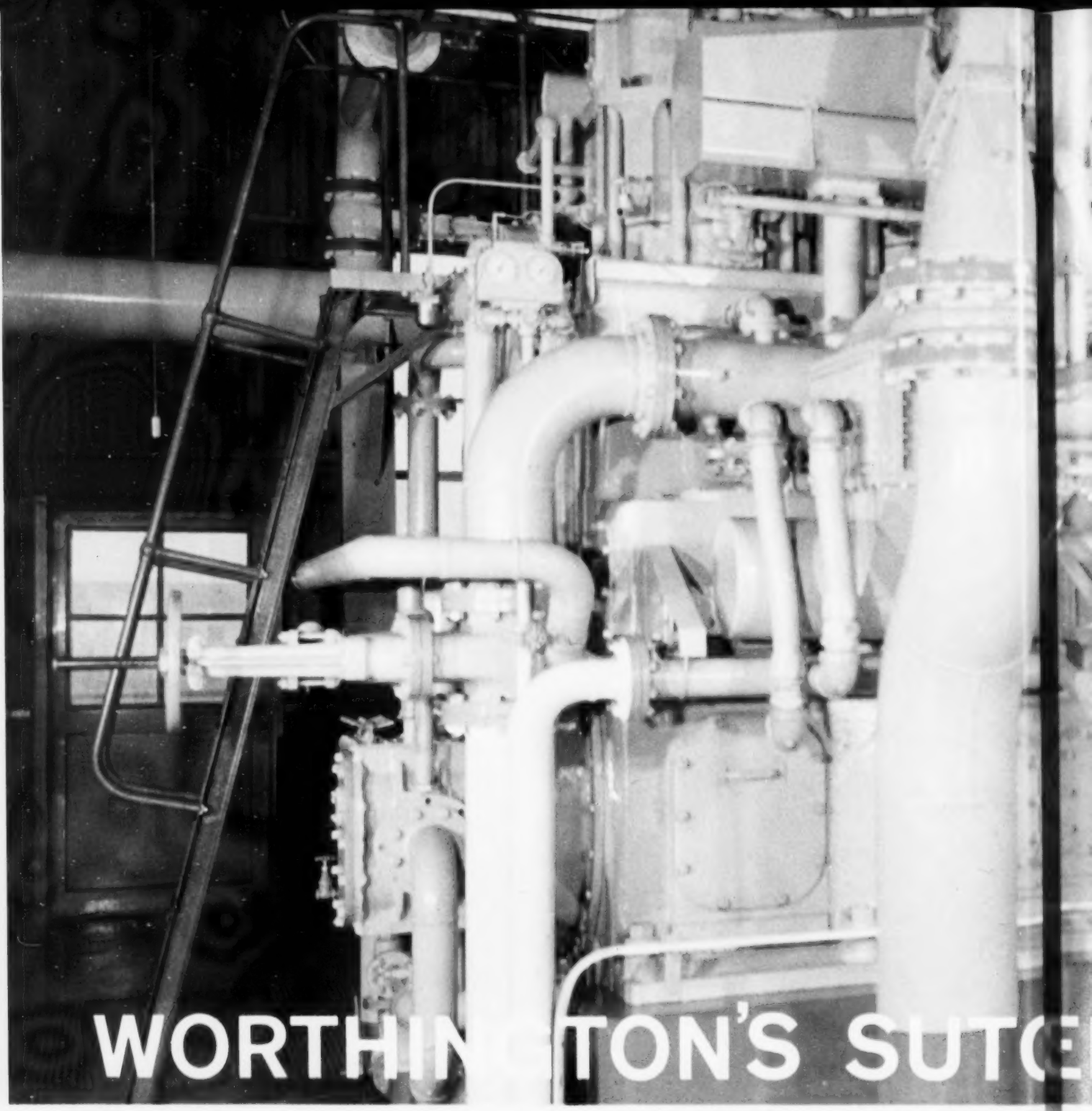
THE ONLY 2-CYCLE ENGINE COMPRESSOR WITH SELF-SUSTAINED TURBOCHARGING!

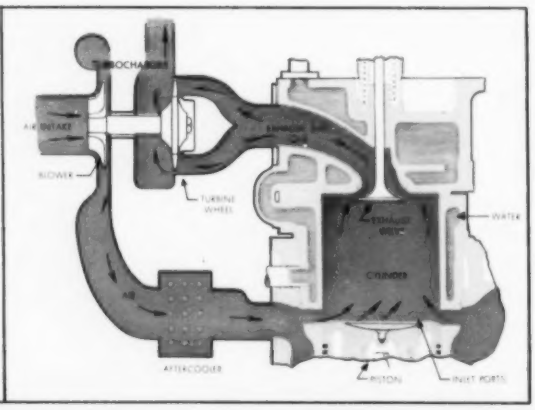
TURN PAGE FOR DETAILS



Easier starting, quicker loading

TURBO-UNIFLO OPERATION

Straight through flow of air in the cylinder, the large inlet port areas (full 360 degrees), and the timed exhaust valves give maximum scavenging effectiveness with optimum back pressure.



Compact, reliable, efficient—the unique SUTC gas engine compressor with independent turbocharging has quickly become the outstanding engine compressor on the market. (Today, SUTC engines are in operation in chemical, petro-chemical plants and in pipeline service throughout the world!) Thanks to the self-sustained turbocharging feature the SUTC develops almost double the hp in the same space required by a non-turbocharged engine. Further, the field-proved Worthington TURBO-

ENGINE COMPRESSOR

most flexible in operation

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URBO-

UNIFLO system provides the most complete scavenging, resulting in a complete absence of residual gases in the combustion chamber.

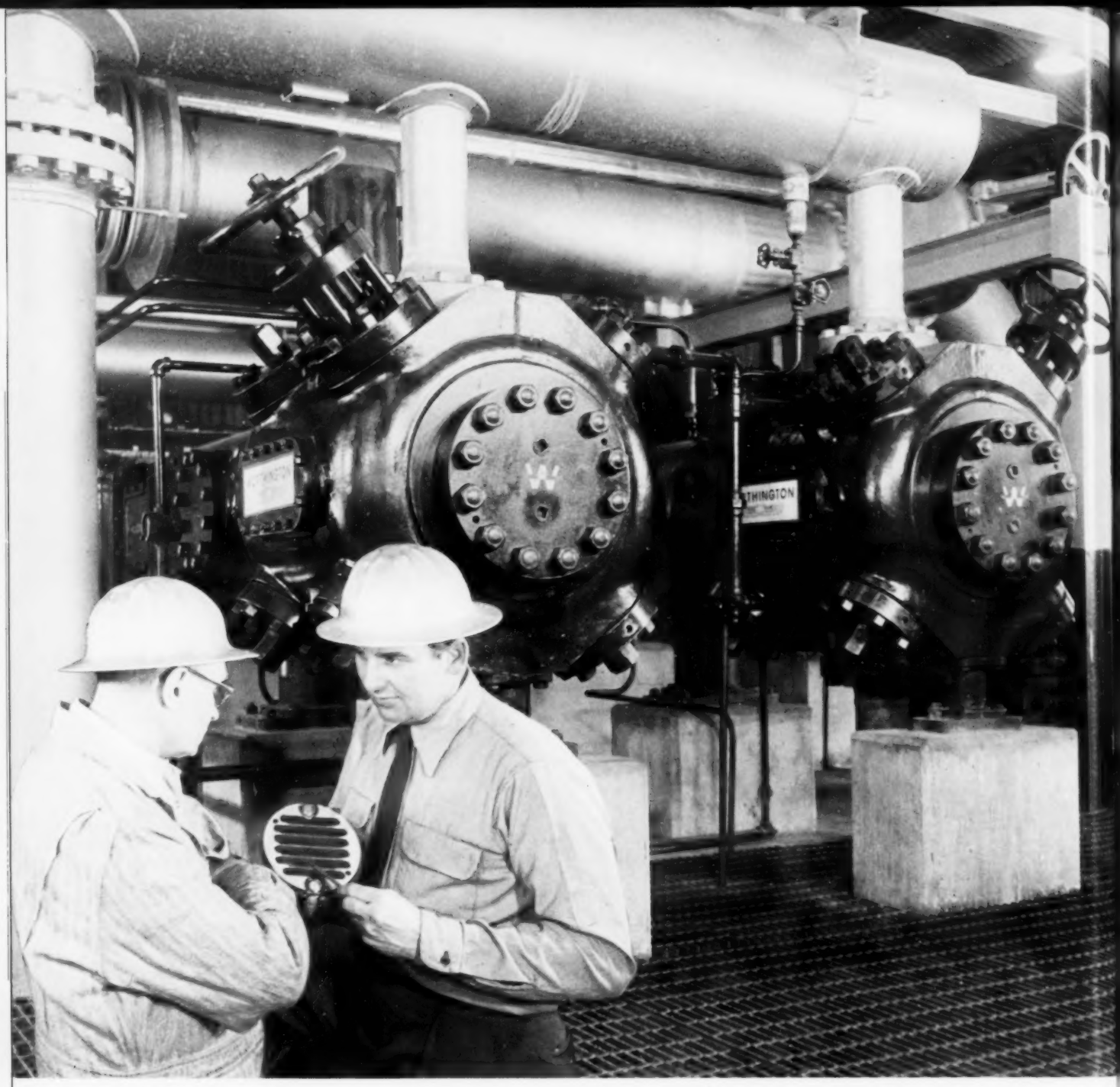
Power — The SUTC integrates exhaust-powered turbocharging with field-proved Uniflo scavenging design for unequalled stability of performance over the complete range of speed and load requirements. The SUTC range: 1250 to 2500 hp. Supplied in 5, 6, 7, 8 and 10 cylinder in-line units.

Economy—No engine compressor in this range is more economical. Low fuel consumption stems from the fact that sufficient exhaust gas energy is applied to give full turbocharged effect through *all* speeds and loads without added mechanical means for driving the supercharger.

Efficiency — Operating at relatively high compression ratio, the Turbo-Uniflo design affords much smoother combustion characteristics than other engines with lower compression ratios. This is due to the positively controlled timing arrangement, cylinder configuration and design of the exhaust manifolding.

For complete details on the SUTC turbocharged gas engine compressor, call your nearest Worthington District Office, or write: Worthington Corporation, Section 43-2, Harrison, New Jersey. In Canada: Worthington Canada Ltd., Brantford, Ont.

WORTHINGTON



compressor-user survey shows

FEATHER VALVE PREFERRED 2 TO 1!

FEATHER VALVE

VALVE A

VALVE B

A recent survey of compressor users put the amazing Feather* Valve first by far in all four operating categories —simplicity of construction, efficiency, low maintenance cost and quiet operation. In addition, the Feather Valve was picked as the preferred compressor valve 2 to 1 over the nearest competing type of valve!

The lightest, fastest-acting valve available, the amazing Feather Valve provides very sharp action with virtually no slip or back-flow. It works with no impact . . . has no buffer plates or cushioning devices. Practically indestructible it assures long life with negligible maintenance costs. When buying your next compressor, look into Worthington's complete line of Feather Valve units. Worthington Corporation, Harrison, N. J.

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WORTHINGTON

What's Happening

among MEN in the INDUSTRY

Wilbur H. Mack has been elected executive vice president of the **American Louisiana Pipe Line** and **Michigan Wisconsin Pipe Line** companies. Mack will continue as director and general attorney for both pipe line companies. He is also secretary of American Louisiana, director and general attorney of the affiliated American Natural Gas Service Company and director, vice president and secretary of American Natural Gas Production Company. Mack has been with the American Natural Gas system since 1952.

Wilbur H. Mack

Wabash Pipe Line Company has announced new directors and officers of its newly-formed company. Directors of the new company are **J. H. Rice, K. E. Tappy** and **C. A. Jackson, Ohio Oil Company**; and **H. R. Wall, John L. Kelly** and **W. L. Kygar,** of **Continental Oil Company.** Officers include Rice, president; **R. M. Slough,** Ohio Oil and Kygar, vice presidents; **Calvin A. Brown,** Ohio Oil, secretary; **R. H. Brown,** Ohio Oil, **John D. Morrow,** and **P. J. Dominic,** Continental, assistant secretaries; **C. A. Jackson,** treasurer, **S. F. Nash,** Ohio Oil, and **L. C. Peters,** Continental, assistant treasurers.

Wabash was formed by Ohio Oil and Continental to construct and operate a 350-mile products pipe line system from Wood River, Ill., to Chicago.

W. J. Bowen has been named senior vice president of **The Houston Corporation.** Bowen was formerly president of **Coastal Transmission Corporation.** Houston Corporation purchased the Coastal company by an exchange of 542,234 shares of Houston Corporation for all outstanding stock of Coastal. Houston Corporation owns Houston Texas Gas and Oil Corporation as well as Coastal and will own, through these two subsidiaries, the entire natural gas pipe line from Texas to Florida which will be built soon.

Edmonton Pipe Line Company and **New Superior Oils of Canada Limited** honored their employes in the Edmonton area for long services at a recent banquet. **Jack Gregg** of New Superior Oils, and **Howard Watson** of Edmonton awarded the employes.

Charles E. Landon, assistant to management of **The Texas Pipe Line Company** has retired after 39 years service with Texaco. He became a clerk for the pipe line Company in 1919 and held several clerical assignments including that of chief clerk of the accounting office. He was named assistant treasurer in 1944 and was promoted to treasurer in 1947. Landon was appointed assistant to management in 1957.

Frank Mair has been appointed controller of **Hudson's Bay Oil and Gas Company Limited.** Mair joined Hudson's Bay in 1950 and was appointed chief accountant in 1954. He replaces **F. F. Sellers** who retired as controller. Mair is also a member of the board of examiners in chartered accountancy for the province of Alberta and a former president and director of the Petroleum Accountants Society of Western Canada.

Frank Mair

Texas Eastern Transmission Corporation announces the appointment of **H. M. McDonald** as vice president. McDonald has been general manager of petroleum products pipe line operations for the past four years.

H. M. McDonald

He will continue as general manager of Texas Eastern's Little Big Inch division, which now handles all petroleum products pipe line operations. Joining the company in 1947, he was division superintendent of gas pipe line operations and became general superintendent of the company's gas transmission division. In 1954 he was appointed general manager of the products pipe line operations.

Before coming to Texas Eastern, McDonald was associated with Tennessee Gas Transmission Corporation, Williams Brothers and the War Emergency Pipelines Inc.

R. G. Strong, director of engineering at **Natural Gas Pipeline Company of America,** recently retired after 28 years service with the gas transmission company. Strong will remain representative of NGPL during the next year at **American Petroleum Institute** and **American Gas Association** meetings, organizations in which he has been active for more than 30 years.

He was employed by Continental Construction Company, which later became NGPL, in 1930. He prepared specifications and directed construction of the 24-inch line to Chicago, one of first long distance, high-pressured transmission lines constructed. He became chief engineer in 1942 and was made director of engineering in 1952.

Andrew J. Shoup

Conrad W. Marvin

Jay J. Ball

George H. Ewing

The election of **Andrew J. Shoup** as vice president and chief engineer and the promotion of four engineers have been announced by **Texas Eastern Transmission Corporation.**

G. L. Jennings

Conrad W. Marven has been named assistant chief engineer; **Jay J. Ball,** supervising engineer; **George H. Ewing,** assistant supervising engineer; and **Gordon L. Jennings,** supervisor of engineering plant and research.

Shoup replaces **Baxter D. Goodrich** who was promoted to senior vice president. He has been with the company since 1947, serving as assistant chief engineer. In this position he supervised construction activities which have increased the natural gas system capacity more than 11 times. He was formerly associated with United Gas Company and Minor and Shoup, consulting engineers.

Marvin joined Texas Eastern in 1947, was named chief of Engineering Plans and Research Division in 1951 and became supervising engineer in 1956. Ball has been with the company since 1955. Formerly he worked with Michigan Wisconsin Pipeline Company, and Kansas Nebraska Natural Gas Company. Ewing started with Texas Eastern in 1948 and in 1956 was named supervisor of plans and research. Jennings, who has been with the company since 1953, was named senior engineer in 1955 and was promoted to assistant supervisor in 1956.

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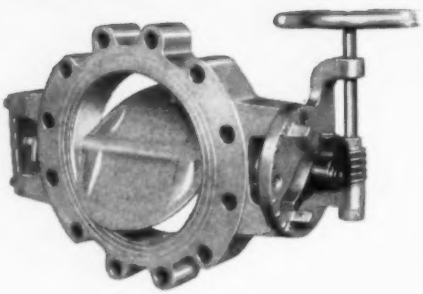

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For use in power generating, cooling, refrigerating, dust collecting, compressing, processing, refining, gas transmission, combustion control, waste disposal and water works—

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James J. Trebilcott

C. J. McInerney

James J. Trebilcott is the new manager of operations and **Charles J. McInerney** is the secretary of **Michigan Wisconsin Pipe Line Company.** Trebilcott has been with the company since 1948 and was appointed assistant to the vice president in charge of operations. He was named assistant manager of operations in 1957.

McInerney became legal assistant to the secretary of Michigan Consolidated Gas Company, an affiliate of Michigan Wisconsin, in 1945. He was appointed assistant secretary for Michigan Wisconsin in 1950. He also is an attorney for the firm and assistant secretary of the affiliated American Louisiana Pipe Line Company.

Arthur E. Bone has been elected president of the **Liquefied Petroleum Gas Association.** Bone, who had been first vice president of the association, is a 22-year veteran of the LPG industry and as independent marketer form Malvern, Penn. He will succeed **Talmage Lovelady** of Worland, Wyo.

Other officers elected include **F. Leslie Fagan,** Gem Automatic Gas Co., hrst vice president: **R. J. Munzer,** Petrolane Gas Service, Inc., second vice president; **A. H. Menuet,** Skelly Oil Co., treasurer: and **Arthur C. Kreutzer,** River Forest Il., member of LPGA executive staff, secretary and assistant treasurer.

D. Michael Curran has been named senior vice president of **Williams Brothers.** Curran's work will include administrative as well as field supervision of Williams Brothers' pipe line projects in the United States and elsewhere.

Curran joined M. J. Crose to found the M. J. Crose Manufacturing Co. in 1946. He served as president of the Crose Company as well as consultant on various pipe line projects.

Michael D. Curran

Oscar C. Nonweiler has been named manager of the **Everglades Pipe Line Company.** Before joining Everglades, Nonweiler was chief engineer for Standard Oil Company (Louisiana); chief engineer of Oklahoma Pipe Line Company; general superintendent of Ajax Pipe Line Company and district superintendent of Cities Service Pipe Line Company.

Dean Crislip and **Jim Tubbs** have announced the transfer of the Pipe Line operations and Crude Oil and Sales de-

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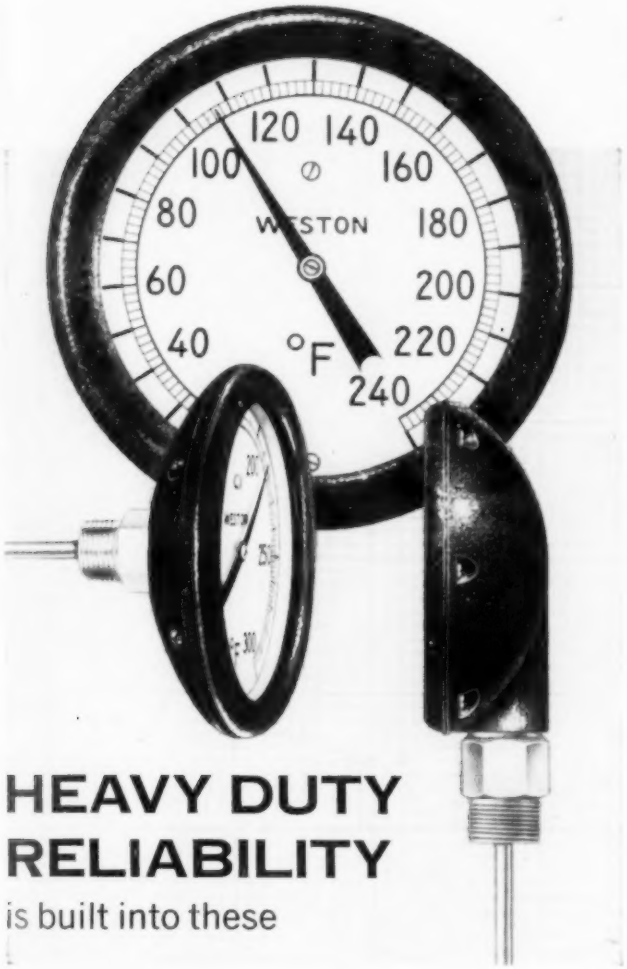

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Model 2221: has a 5" diameter head with 9" scale.

Model 2231: 6" diameter head with 12" scale.

Model 1221: straight form—basically the same as Model 2221, but with scale parallel to stem. Stem can be located in any one of 24 positions around the periphery of the head.

For full information, call your local Weston representative, or write to Weston Instruments, Division of Daystrom, Inc., Newark 12, N. J. *In Canada: Daystrom Ltd., 840 Caledonia Rd., Toronto 10, Ont. Export: Daystrom Int'l., 100 Empire St., Newark 12, N. J.*

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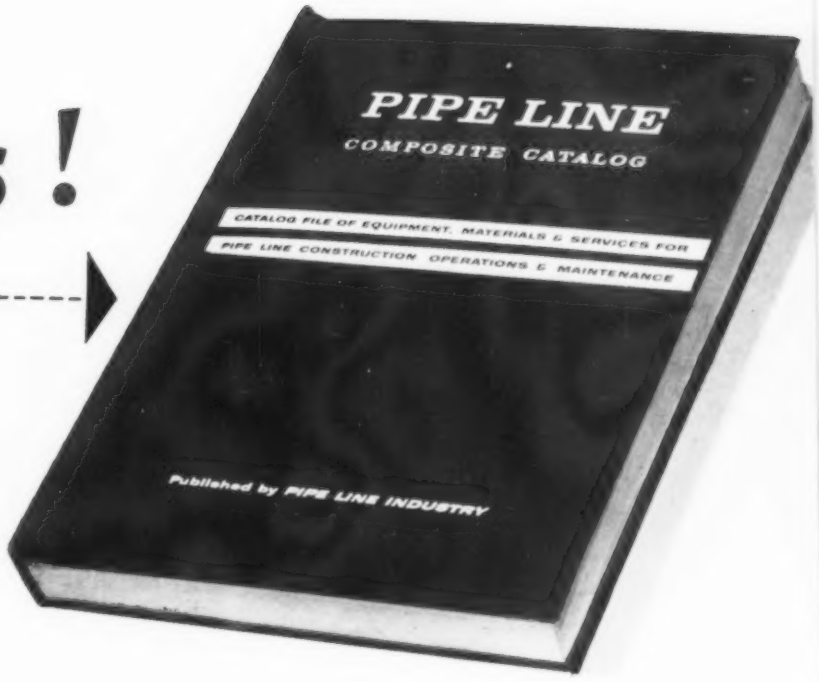
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PIPE LINE COMPOSITE CATALOG

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partments of **Kerr-McGee Oil Industries, Inc.** from Tulsa to Oklahoma City.

Crislip is general manager of pipe line operations, and Tubbs is general manager of crude oil purchases and sales. The move places all central offices of the company under one roof in the newly expanded Kerr-McGee Building in Oklahoma City.

John E. Green, manager of operating services department for **Shell Pipe Line Corporation**, has been named chairman of the transportation committee of the Petroleum Division, ASME.

Green will be responsible for the transportation committee sessions of the 1958 Petroleum Mechanical Engineering Conference to be held in Denver next fall. More than 800 executives and engineers from the petroleum industry are expected to attend the annual conference starting September 21.

Vernon L. Sadler, Roy E. Cook and **Les F. Sadler** have organized the **Sadler Brothers Pipeline Construction Co.** of Oklahoma City.

Vernon Sadler has been welding superintendent for R. B. Potashnick the past seven years. Cook previously had been assistant vice president of Schafer Drilling Co. Bill Sadler has been with Vaugh Taylor Construction Co., O. C. Whitaker, Anderson Brothers, R. B. Potashnick and H. C. Price Co.

First project for Sadler Bros. is a 21-mile gathering system near Moore, Okla. for Sunray Mid-Continent Oil Co.

W. A. Campbell

W. E. Locher

Trans-Arabian Pipe Line Company has announced the election of two vice presidents. **W. A. Campbell**, manager of government relations, and **W. E. Locher**, manager of operations, have received the promotions.

Campbell joined Tapline in 1947. Previously he served as president of the American Levant Shipping Company. He also had been field archaeologist with the Institute for Advanced Study in Princeton, N. J.

Locher has been with the company since 1950. Before joining Tapline he headed Pipe Line division of Creole Petroleum Corporation. He began his career as electrical engineer with Lago Petroleum Corporation; in 1941 he joined Plantation Pipe Line Co. and became division superintendent at Baton Rouge, La.

E. J. Jandacek has been promoted to chief engineer for **Texas Gas Transmission Corporation.** Serving as assistant chief engineer since he joined the company in 1949, Jandacek replaces **H. L. Stowers.**

E. J. Jandacek

Stowers had been chief engineer since 1943 and served in dual capacity of vice president and chief engineer since 1957. At Texas Gas Jandacek has been responsible for the engineering phases of construction of much of the company's 3,700 miles of large-diameter natural gas pipe lines from the Gulf of Mexico to Ohio.

DEATHS

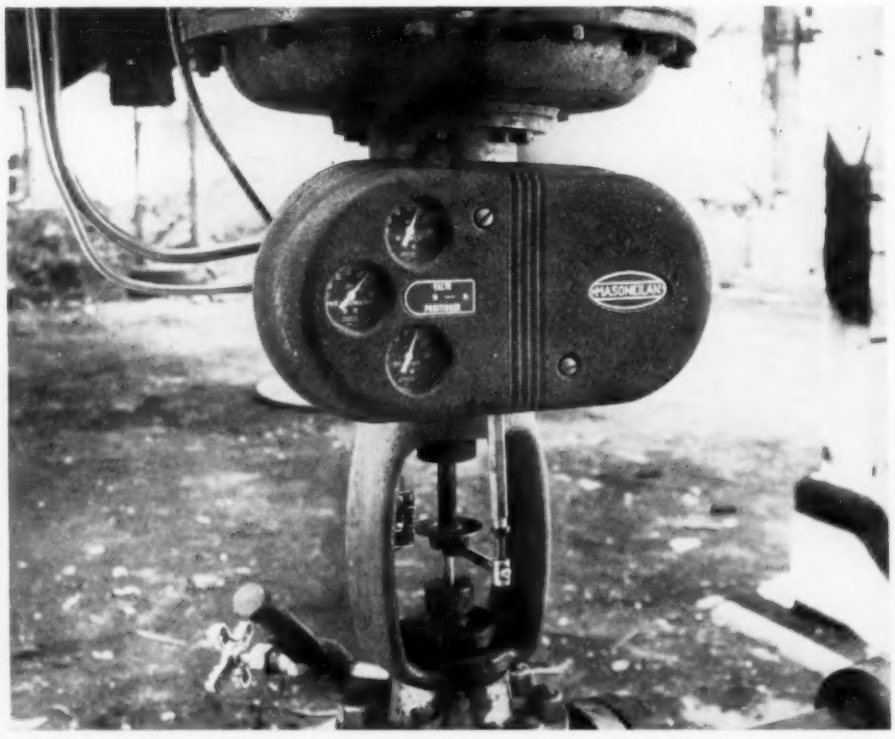
Rupert L. Adams, 55, Shell Pipe Line Corporation station chief engineer at Wheeler, Texas, died April 30. Adams had been with the company for 29 years.

James W. Williams, 56, Shell Pipe Line Corporation, died May 1 in an Oklahoma City hospital. Williams had been with the company for 17 years..

John Leland Shoemaker, 57, financial vice president, Service Pipe Line Company, Tulsa, died May 26. He had been with Service and predecessor companies since 1919.

Jackson L. Culbertson, 64, a retired Texas Pipe Line Co. engineer, died March 20.

Raymond Harvey, 65, retired chief oil dispatcher for Service Pipe Line Company, died March 23.



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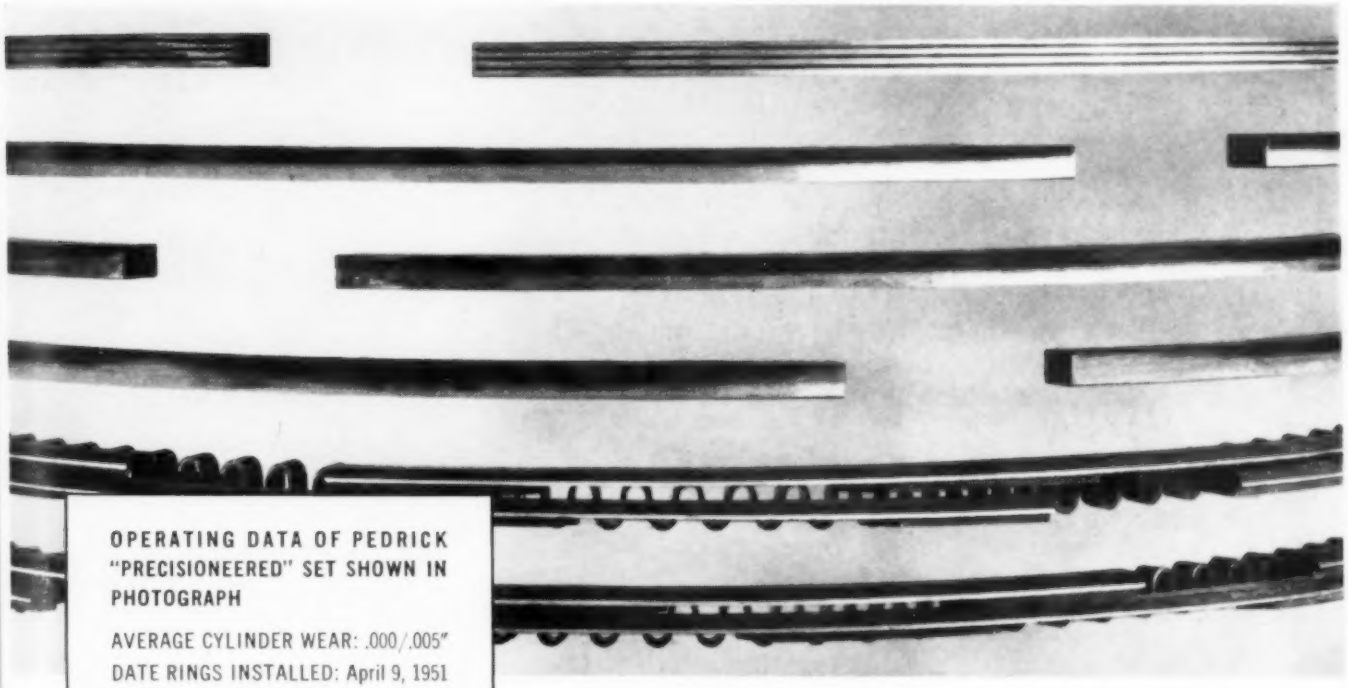
Available in all sizes for automatic, semi-automatic, or manual operation. Steam or electric reactivation.

40,622 hours of operation

. . . an average of 6,350 h.p. hrs. per gal. total lube oil consumption.

The photograph shows Pedrick Piston Rings removed from a Cooper-Bessemer GMVTF 10 cylinder engine after 40,622 hours of operation. Note carefully how the face-wear on the rings (the bright area) extends only half way up. After more than six years of *full load* service, these Pedrick rings are practically as good as new.



OPERATING DATA OF PEDRICK "PRECISIONEERED" SET SHOWN IN PHOTOGRAPH

AVERAGE CYLINDER WEAR: .000/.005"
DATE RINGS INSTALLED: April 9, 1951
DATE RINGS REMOVED: June 27, 1957
TYPE LUBE OIL: DTE No. 3 MAGNOLIA
RATED HORSEPOWER: 1100
MAXIMUM OVERLOAD: 10%
LUBE OIL CONSUMPTION: CRANKCASE—39,600 H.P. Hours per Gal. LUBRICATORS—(14 qts. per day) 7,530 H.P. Hours per Gal.
TOTAL LUBE OIL CONSUMPTION (CRANKCASE AND LUBRICATORS): 6,350 H.P. Hours per Gal.

For longer life at full power, make Pedrick "Precisioneered" Piston Ring Sets your *standard* replacement sets. You'll find your Pedrick engineer will be glad to call and help you solve any special problems. Write, wire or phone: WILKENING MANUFACTURING CO., Phila. 42, Pa. In Canada: Toronto 2.

Pedrick PISTON RINGS

PEDRICK PIONEERED CONFORMABLE PISTON RINGS FOR BIG-BORE ENGINES

AGAIN "Something New and Better...

Stainless Steel Banding

Extra Strength

Double Convolute

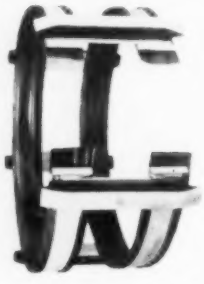
Maloney

MOLDED PULL-ON CASING SEAL

The molded seal for **any job.** Double **accordian** design provides flexibility for eccentric installations, with plenty of room for longitudinal movement in **either** direction. Ribbed inner surfaces and stainless steel bands seal the rubber to the pipe to form an impervious joint. Maloney compounded rubber is extra thick at pressure and shear points eliminating the need for additional shielding. Long life, free from checking and other aging symptoms, is assured by production quality control of rubber compounding and molding. Installs with Stainless Steel banding for long life. Available immediately in the full range of size combinations.

Maloney

MODEL 58 FULL ENCIRCLEMENT CRADLE



The Cradle that supports the carrier **all the way around.** The Model 58 Centering Cradle is a double steel band with ribbed rubber lining to provide insulation and protect pipe wrap. Runners are steel and Neoprene, providing double insulation, **performance proven** in miles of crossings on the Model 55 Maloney insulators. Built-in tension in the cradle bands hold it firmly in place during installation — without bolting. The Model 58 cradle is available in any combination of carrier-casing sizes to your specifications.

F. H. Maloney COMPANY

From the Irishman"

HOUSTON, TEXAS

LOS ANGELES • PITTSBURGH • TULSA

WHO'S MEETING WHERE

July

Gordon Research Conference on Instrumentation, Colby Jr. College, New London, N. H., July 28-Aug. 1.

August

Society of Automotive Engineers, National West Coast Meeting, The Ambassador, Los Angeles, August 11-14.

American Institute of Electrical Engineers, general meeting, Sacramento, Aug. 19-22.

Appalachian Gas Measurement Short Course, University of West Virginia, Morgantown, W. Va., Aug. 25-27.

September

Pacific Coast Gas Association, Annual Convention, Multnomah Hotel, Portland, Oregon, Sept. 2-4.

New Jersey Gas Association, Annual Meeting, Spring Lake, New Jersey, Sept. 5.

Independent Natural Gas Association of America, annual membership meeting, Roosevelt Hotel, New Orleans, Sept. 15-16.

American Institute of Electrical Engineers, conference of petroleum industry, Baker Hotel, Dallas, Sept. 15-17.

Instrument Society of America, 13th Annual Instrument Automation Conference and Exhibit, Philadelphia, Sept. 15-19.

Southeastern Gas Association, Annual Meeting, Sir Walter Hotel, Raleigh, N. C., Sept. 17-19.

ASME, Petroleum division, mechanical engineering conference, Cosmopolitan Hotel, Denver, Sept. 21-24.

Seventh International Gas Conference, Rome, Italy, Sept. 22-25.

Mid-Continent Oil & Gas Association, Louisiana-Arkansas division, annual meeting, Roosevelt Hotel, New Orleans, Sept. 25-26.

ASME, power conference, Hotel Statler, Boston, Sept. 28-Oct. 1.

October

NACE, Northeast Regional Conference, Hotel Somerset, Boston, Oct. 5-8.

Texas Mid-Continent Oil and Gas Association, annual meeting, Statler-Hilton Hotel, Dallas, Oct. 7-8.

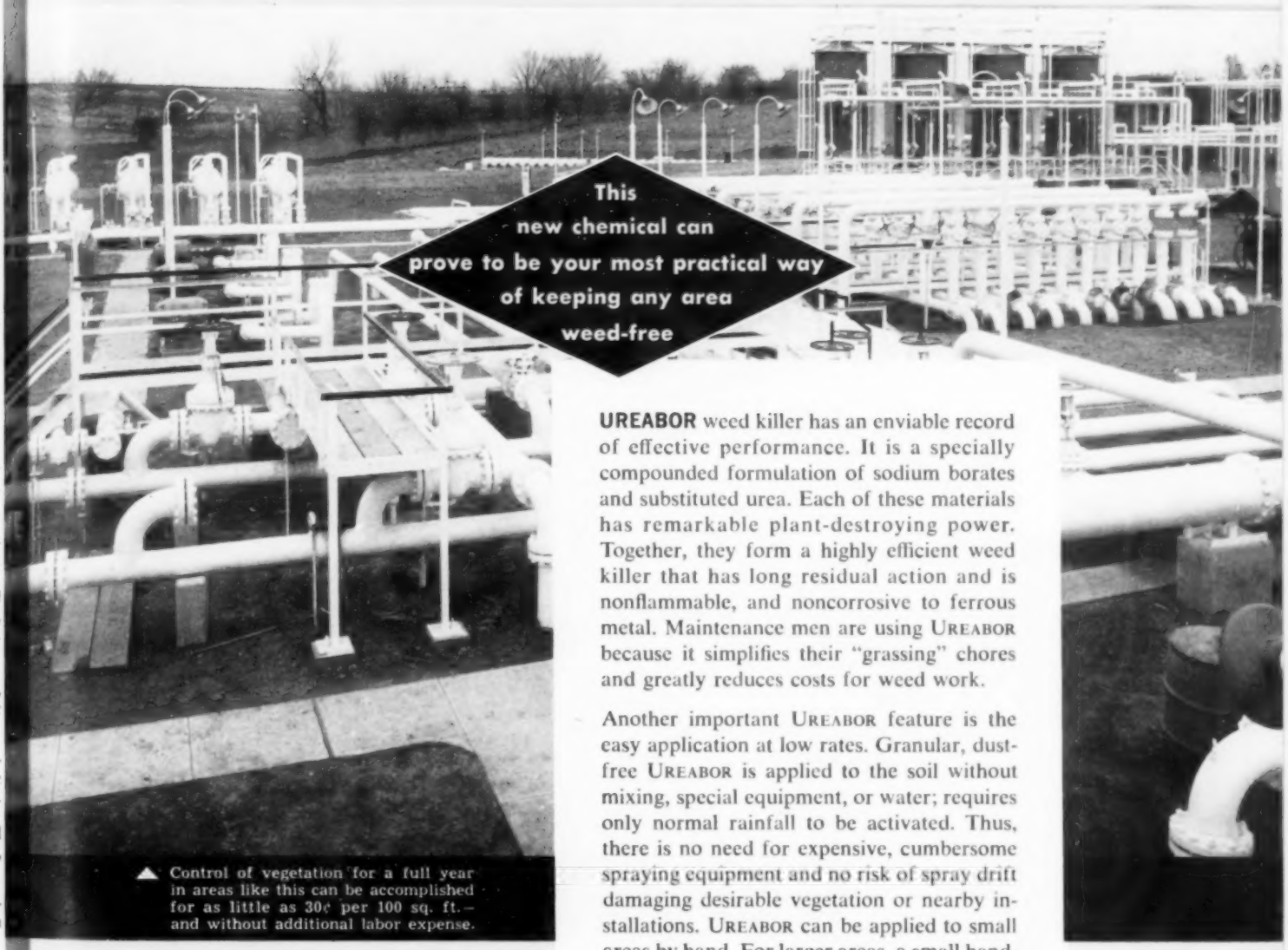
OIL PROGRESS WEEK, Oct. 12-18.

American Gas Association, annual convention, Atlantic City, N. J., Oct. 13-15.

National Electronics Conference, Hotel Sherman, Chicago, Oct. 13-15.

Now...controlling vegetation is easier-cheaper-

with **UREABOR®** weed and grass killer



This new chemical can prove to be your most practical way of keeping any area weed-free

▲ Control of vegetation for a full year in areas like this can be accomplished for as little as 30¢ per 100 sq. ft.—and without additional labor expense.

UREABOR weed killer has an enviable record of effective performance. It is a specially compounded formulation of sodium borates and substituted urea. Each of these materials has remarkable plant-destroying power. Together, they form a highly efficient weed killer that has long residual action and is nonflammable, and noncorrosive to ferrous metal. Maintenance men are using UREABOR because it simplifies their "grassing" chores and greatly reduces costs for weed work.

Another important UREABOR feature is the easy application at low rates. Granular, dust-free UREABOR is applied to the soil without mixing, special equipment, or water; requires only normal rainfall to be activated. Thus, there is no need for expensive, cumbersome spraying equipment and no risk of spray drift damaging desirable vegetation or nearby installations. UREABOR can be applied to small areas by hand. For larger areas, a small hand-operated sling strap spreader is available for just $10.75 delivered anywhere in the U.S.A.

UREABOR weed killer is conveniently packaged in easy-to-handle 50-lb. multi-wall paper sacks. It is economical, always ready for use—dry. To learn more about UREABOR—write:

AGRICULTURAL SALES DEPARTMENT

United States Borax & Chemical Corporation

PACIFIC COAST BORAX COMPANY DIVISION

630 SHATTO PLACE • LOS ANGELES 5, CALIFORNIA

Write for Bulletin

PIPELINE VENTS AND MARKERS

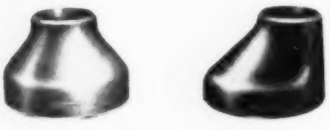
FLEET-LINE CO.
P. O. BOX 276-K
SHREVEPORT
LOUISIANA

Write for Specifications Folder

FLEET-LINE®

WELDING FITTINGS

REDUCERS: Concentric and eccentric. Nominal pipe sizes 1" to 30", ASA B16.9, ASTM A234. Schedules 10 to 160, stainless steel, and other alloys. Special lengths and sizes.



SADDLES: Conventional, and for pressure vessel heads. Nozzle sizes from ¼" to 24". Fleet-Line saddles weld neatly into place in much less time, and with much less welding rod.

Complete encirclement saddles.

Fast interested service.
Write for Literature.

STEEL FORGINGS, Inc.

P. O. Box 276K • Shreveport, La.

What's Happening among SERVICE and SUPPLY MEN

James H. Caldwell

Ralph L. Reynolds

Cooper-Bessemer Announces Personnel Appointments

Cooper-Bessemer Corporation announces three personnel appointments in sales and service organizations.

Robt. L. Kietzman

James H. Caldwell has been named district service manager, Pacific Coast; Ralph L. Reynolds is the new branch manager, Grove City sales office; and Robert L. Kietzman has been appointed sales engineer for the St. Louis branch.

Caldwell will be responsible for the supervision of all Cooper-Bessemer service activities in the Pacific Coast area. Caldwell has served in the Research, Production Testing and Service departments since joining the company in 1936. Reynolds fills the position vacated by Fred W. Green, who retired recently. He will be responsible for application and sale of compressors, diesel, gas and gas-diesel engines in western Pennsylvania and western New York. Reynolds has been associated with Cooper-Bessemer since 1926, having worked in the Service and Sales department since 1936.

Kietzman, who has been with the company for two years, will work on engineering and sales contacts with users of compressors and engines in Missouri and southern Illinois areas.

Myoco Limited Formed To Make Pipe Line Equipment

Morris-Young-Owens Company, Houston, announces the formation of Myoco Limited, Toronto, Ontario. Myoco will manufacture and service the same line of pipe line equipment in Canada as Morris-Young-Owens does in the United States.

I. L. Jones is superintendent and in charge of the operation; J. Wilson Elden is office manager.

Rights Given BTR Industries To Use Tube Turns Process

Tube Turns Plastics, Inc., has granted rights to BTR Industries, Ltd., of London to manufacture unplasticized polyvinyl chloride products by a special process. A license agreement provides for rights to the Hendry injection molding process, furnishing of presses and technical counsel.

BTR Industries has 10 factories in Great Britain, is a major manufacturer of plastic and rubber products and engages extensively in international trade.

Sooner Boomer To Make Pipelaying Equipment

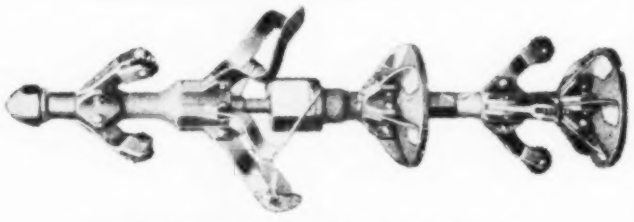
C. Hubert Gragg announces that Sooner Boomer pipelaying equipment will be manufactured by Sooner Boomer Manufacturing Division. It was formerly manufactured by Pneumatic Pipelayers, Inc.

The Sooner Boomer equipment is adaptable to many types of pipe construction including transmission and distribution lines.

Edward T. Sponberg, Jr. Joins Atlas Pipe Staff

Edward T. Sponberg, Jr., has joined the sales staff of Atlas Pipe Inc. Formerly Sponberg had been associated with Tex-

Go-Devil



Standard Model Northrup Go-Devil with leather disc drivers

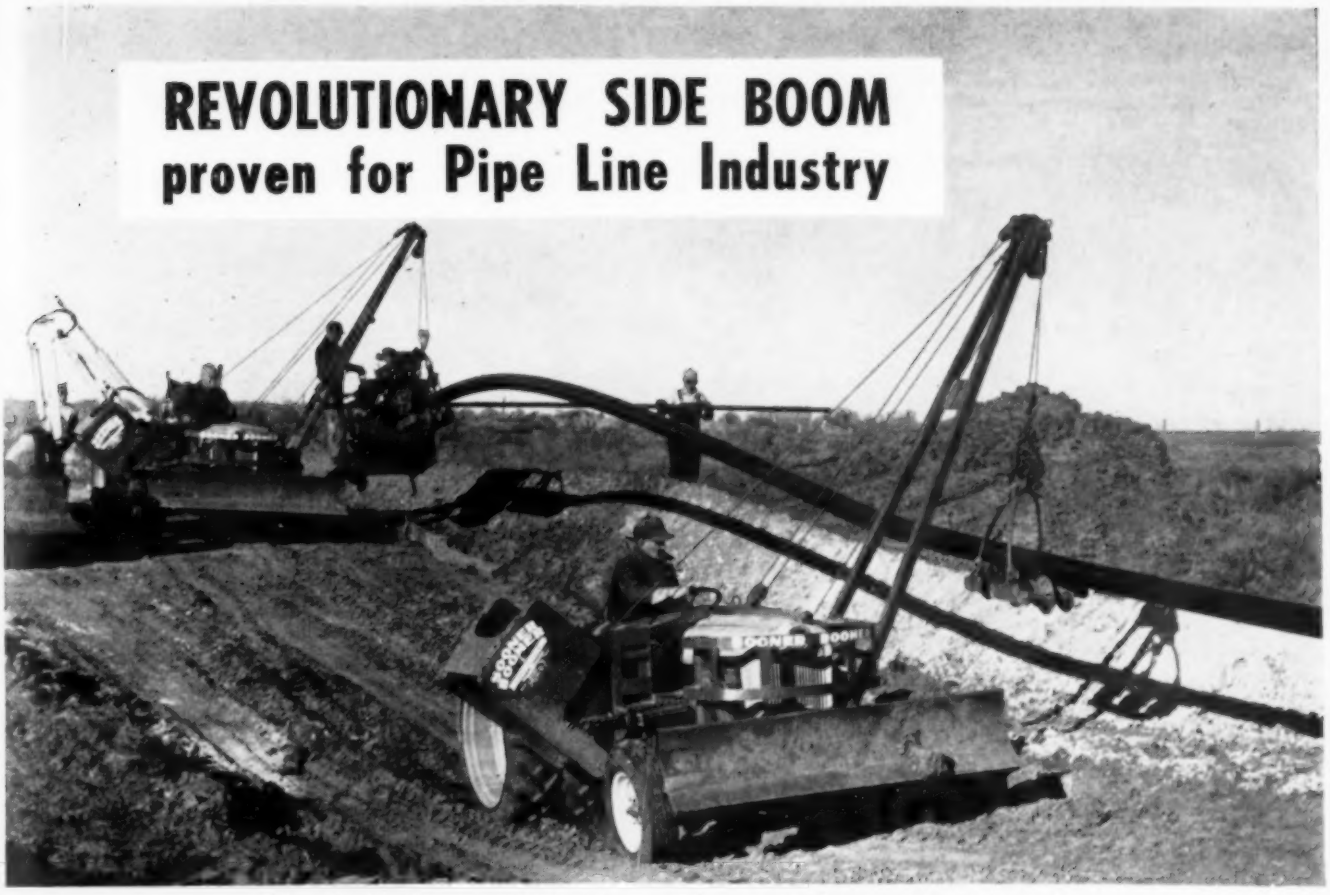
G. A. COTTEN CO.

Manufacturer of

NORTHRUP GO-DEVILS & TRANSIT PIPE LINE SCRAPERS

P. O. Box 5332 — Tulsa, Okla.

REVOLUTIONARY SIDE BOOM
proven for Pipe Line Industry



The Only Proven Side Boom Mounted On Rubber Tires!

Rubber Tire Mounted
SOONER BOOMER
Handles 10-inch Pipe!

LOW-COST SOONER-BOOMER DOES THE WORK OF 2 CONVENTIONAL MACHINES!

The Sooner-Boomer is the world's first side boom mounted on rubber tires. Designed to handle 10" pipe, this revolutionary machine eliminates unnecessary right-of-way damage on city work—eliminates the need of pipe stringing along city streets ahead of ditch. A low center of gravity makes the Sooner-Boomer highly stable, loaded or unloaded. It operates at road speeds on back haul, and is equipped with a swamper platform. A 12-foot boom makes it possible to lower in over spoil. Power up and power down on all cables assures ultimate safety and precision line-up. The Sooner-Boomer easily lowers in or bends 8-inch pipe. Excellent performance on clean-up and ditch dressing. The Sooner-Boomer is designed to put all weight on wheels, eliminating any strain on engine, transmission and differential.

OPTIONAL: 7 foot angle dozer; rear-end winch; 8 forward and 2 reverse speed transmission; trailer hitch; 3-pin connected, boom mounted bending shoe (available in 2, 4, 6 and 8" sizes).

LIFTING CAPACITY	8 Ft. Radius 2450 lbs. plus
4 Ft. Radius 3750 lbs. plus	10 Ft. Radius 1500 lbs. plus

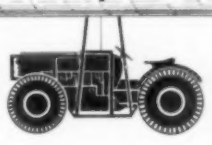
USING FORD SERIES 600 AND SERIES 800 TRACTORS

Check These Features

- **Mounted On Rubber Tired Tractor!**
- **Power Steering!**
- **Highly Maneuverable!**
- **Road Speed up to 27 MPH!**
- **No Hauling Problems!**
- **All-Hydraulic Operation!**
- **Hydraulic Controlled Counter Weights!**
- **Perfect Operator Visibility!**
- **12-Foot Boom Handles 10" Pipe!**
- ***Lowest Initial Cost!***
- ***Lowest Operating Cost!***
- **Six months warranty from date of purchase on tractor and SOONER BOOMER!**

SOONER BOOMER MFG. DIV.

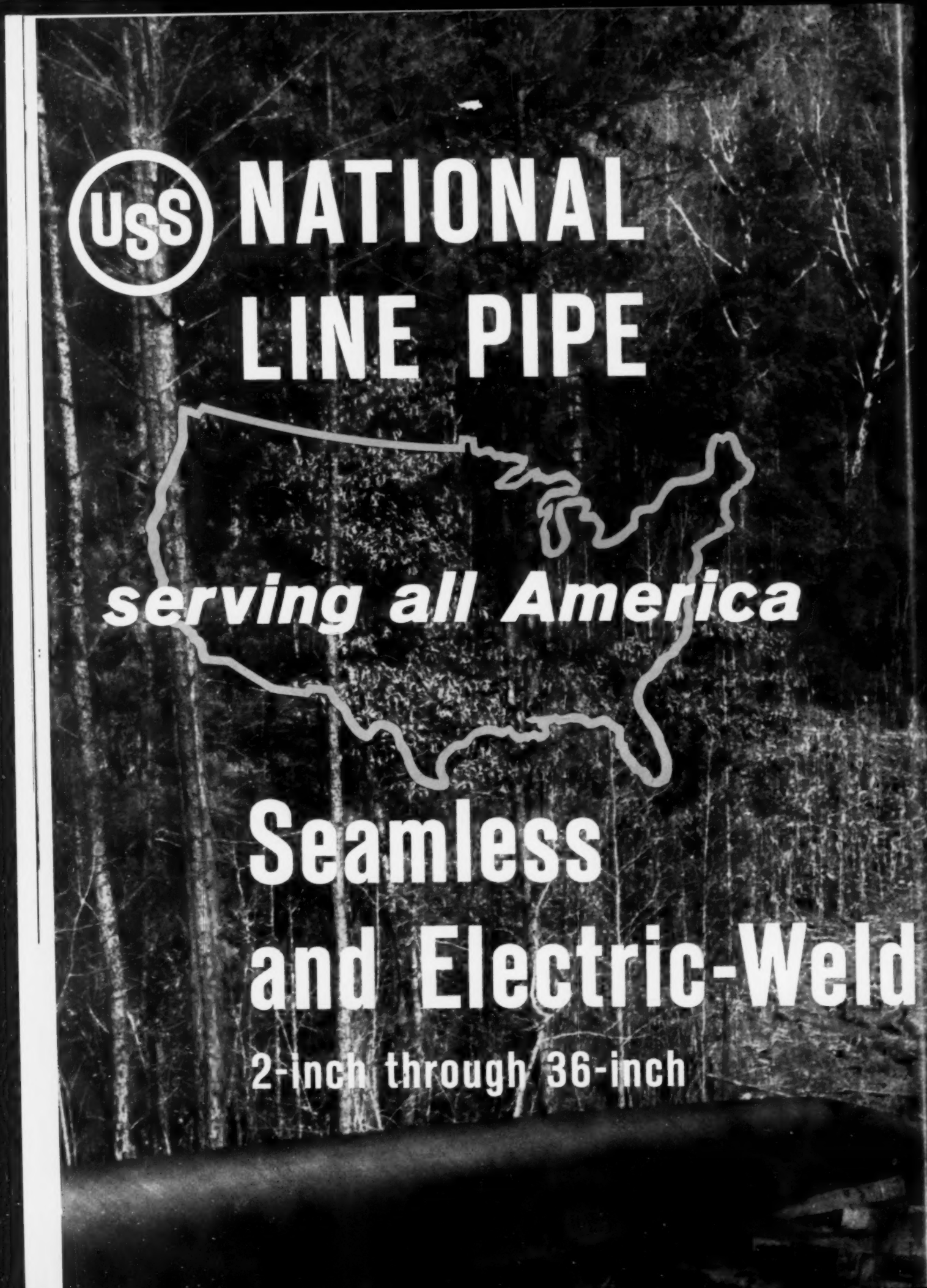
Oklahoma City Oklahoma

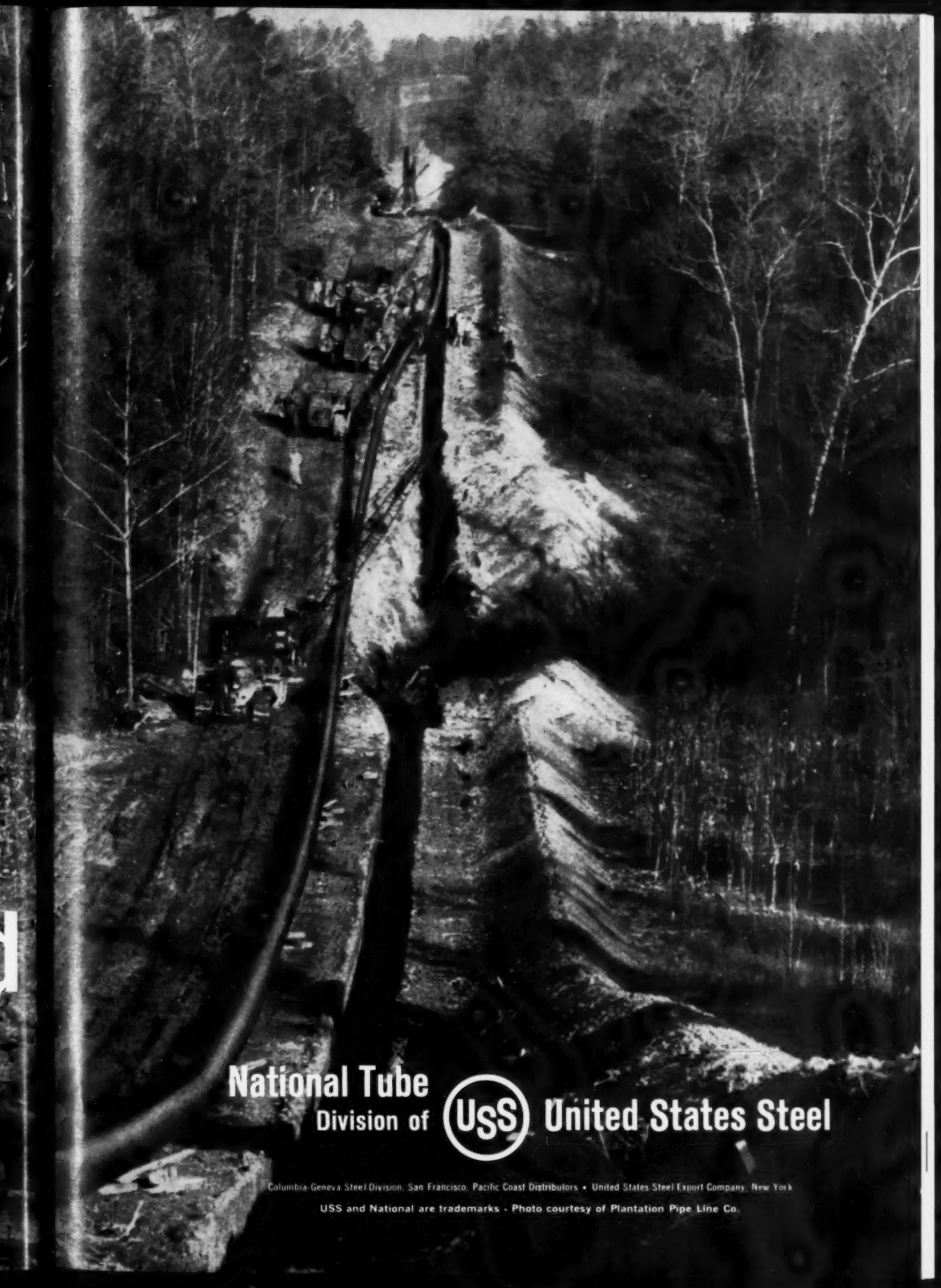


PHONE TR 8-2127

P.O. BOX 8686

For more data on advertised products, use Readers' Service Cards, last page.


USS
NATIONAL
LINE PIPE
serving all America
Seamless
and Electric-Weld
2-inch through 36-inch



Columbia-Geneva Steel Division, San Francisco, Pacific Coast Distributors • United States Steel Export Company, New York

USS and National are trademarks - Photo courtesy of Plantation Pipe Line Co.

Tube, Inc., as purchasing agent and traffic manager. Previously, he had been assistant purchasing agent, in production control, for National Supply Co., in Houston.

Atlas Pipe is engaged in the distribution of pipe and performs various other pipe services, particularly for the oil and gas industry.

Chairman and President Elected By ALCO Products, Inc., Board

Perry T. Egbert has been elected chairman and William S. Morris president by the board of directors of ALCO Products, Inc. Egbert had been president of the company and Morris executive vice president.

Egbert has been with ALCO since 1920 and served in production, sales and engineering capacities until he was named a vice president in 1944. He was raised to president in 1952.

Morris has been associated with ALCO since 1922. In 1940 he became vice president of Montreal Locomotive Works and executive vice president in 1944. He was transferred to ALCO New York office as vice president and in 1952 was elected executive vice president.

L. B. Rainey Promoted By Jones & Laughlin

Jones & Laughlin Supply Division announces several appointments. L. B. Rainey has been named assistant manager, Project Sales department; C. E. Sample has been appointed salesman for Wichita Falls, Texas, and S. D. Martin has been transferred to Calgary Sales department.

L. B. Rainey

Rainey has been with the company in various sales capacities for 22 years. The Project Sales department is concerned with distribution of line pipe, valves, fittings and other products for construction pipe lines and similar projects in the oil industry.

Sample joined Jones & Laughlin in 1952 and became store manager in Casper, Wyo., in 1956. Martin had been salesman at Estevan, Saskatchewan.

Seismograph Service Elects E. D. Wilson Board Member

Seismograph Service Corp. elected Treasurer E. D. Wilson to the board of directors at the annual stockholders meeting.

Wilson will succeed F. B. Leedy, vice president of Seismograph Service Corp. (International) and Seismograph Service of Canada, who retires this month. Wilson joined SSC in 1946 and was responsible for the accounting operations for the parent company and its 13 subsidiaries. In 1947 he became treasurer.

In other personnel appointments J. F. Blaisdell was promoted to vice president, and S. W. Fruehling was named vice president of SSC (International).

Blaisdell has been with SSC since 1943 and has been personnel department head since 1948. Fruehling, who has been with SSC since 1941, was manager of company operations in Brazil before his promotion.

NOW! Get CLEAN-AS-A-WHISTLE

WEED CONTROL

in Non-Crop Areas

- ☐ tank farms
- ☐ pipelines
- ☐ pumping stations
- ☐ firebreaks
- ☐ fence rows
- ☐ paths and roads
- ☐ drainage ditches

with amazing new UROX® WEED KILLER

Longer lasting! Saves time and money! Now you can control troublesome vegetation *for a longer time and at lower cost* than ever before—with UROX, General Chemical's sensational new weed killer.

You need only one application a year under normal growing conditions! Small quantities do the job! And results "carry over"! Light "booster" doses keep most areas weed-free from season to season. Easy to use, too!

Write for complete information

Allied Chemical

GENERAL CHEMICAL DIVISION
40 Rector Street, New York 6, N. Y.

R. M. McFarland

Paul B. Renfrew

Renfrew, McFarland Promoted By Ralph N. Brodie Company

Paul B. Renfrew has been named manager of pipe line and refinery sales, and Robert M. McFarland has been appointed Northern California division manager for Ralph N. Brodie Company.

Renfrew has been with the company for 22 years having held various positions including that of chief engineer. McFarland joined Brodie in 1947 and has been instrumental in introducing a number of new applications of positive displacement metering in liquid blending, container filling, pipe line and process fields.

Cleveland Trencher Co. Appoints Distributor

West Virginia Tractor & Equipment Co. has been appointed distributor for the Cleveland Trencher Co.'s complete line of trenchers, sidecranes, backfillers and tampers.

The company will handle sales, parts and service of Cleveland equipment in the state of West Virginia. Cleveland trenchers and backfillers have a wide range of applications which can be employed on projects of all types. The line also includes two sidecrane-backfiller models.

Ruysser Elected President Of Oilfield Tank Association

Henry A. Ruysser, Jr., executive vice president of Black, Sivalls & Bryson, Inc. has been elected president of the Oilfield Tank Manufacturers Association.

Ruysser has served as president of the

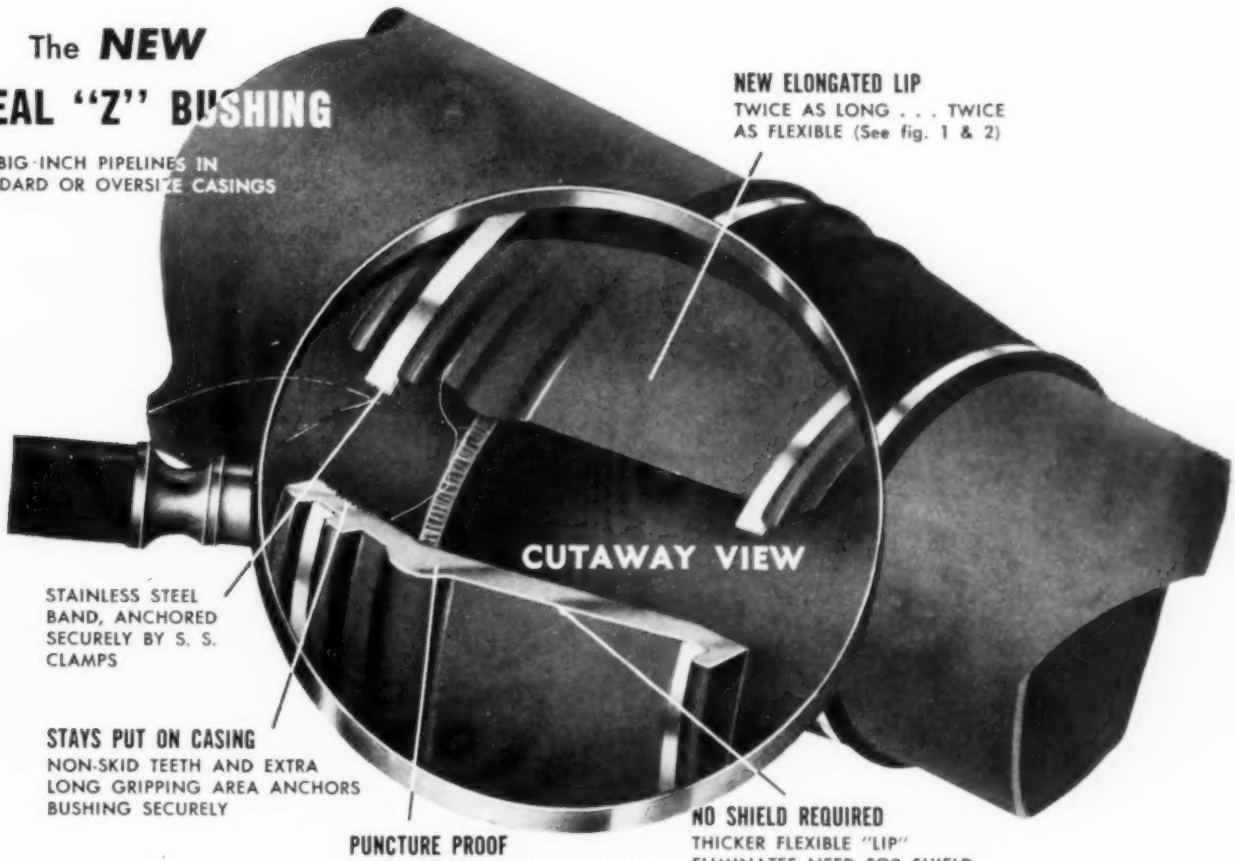
TAKE A CLOSE LOOK . . .

. . . AT A REAL CASING SEAL

The **NEW**

WmSEAL "Z" BUSHING

FOR BIG-INCH PIPELINES IN STANDARD OR OVERSIZE CASINGS



NEW ELONGATED LIP
TWICE AS LONG . . . TWICE AS FLEXIBLE (See fig. 1 & 2)

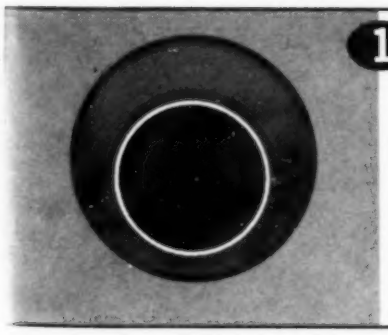
STAINLESS STEEL BAND, ANCHORED SECURELY BY S. S. CLAMPS

STAYS PUT ON CASING
NON-SKID TEETH AND EXTRA LONG GRIPPING AREA ANCHORS BUSHING SECURELY

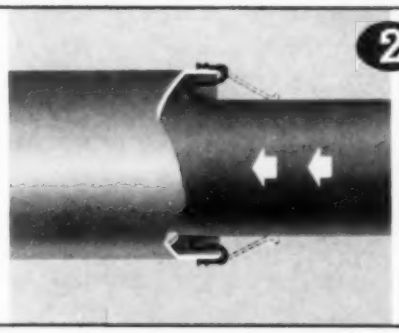
PUNCTURE PROOF
EXTRA THICK SHOULDER (BUNA-S SYNTHETIC RUBBER) PREVENTS CASING EDGE FROM CUTTING THROUGH BUSHING

NO SHIELD REQUIRED
THICKER FLEXIBLE "LIP" ELIMINATES NEED FOR SHIELD. WITHSTANDS WEIGHT OF BACK-FILL EARTH

A TIGHT SEAL UNDER ADVERSE CONDITIONS



WHEN PIPE IS OFF CENTER . . .



WHEN ENDO MOVEMENT OCCURS

FOR PIPELINES IN SERVICE

IMPROVED WmSEAL SPLICED "Z" BUSHINGS ARE AVAILABLE

(Write for Literature)

T.D. Williamson, Inc.

P. O. BOX 4038 TULSA 9, OKLAHOMA

REPRESENTATIVES: HOUSTON • AMARILLO • PLAINFIELD, N. J. JOLIET, ILL. • JACKSON, MICH. • LOS ANGELES • SAN FRANCISCO BARTLESVILLE, OKLAHOMA • SEATTLE • SALT LAKE CITY • EDMONTON TORONTO • VANCOUVER • BUENOS AIRES • CABIMAS, ZULIA, VENEZUELA • DURBAN, NATAL, S. AFRICA • PARIS, FRANCE • SIDNEY, AUST.

For more data on advertised products, use Readers' Service Cards, last page.

association since May, 1957, filling out the incompleted term of I. W. Lovelady, Sivalls Tanks, Inc. Elected vice president was E. M. Burt, president of Burcamp Steel Company. J. E. Fogarty, vice president Graver Tank and Manufacturing Company, was named treasurer. Other members of the executive committee include G. O. Marchant, president of Continental Tank Company; Tyson Smith, president of Tyson Smith Company; Charles Sivalls, president of Sivalls Tanks, Inc.; and C. D. Haehl, Jr., general manager, Production Equipment division, Parkersburg Rig and Reel Company.

Tretolite Company of California Names Anderson Plant Manager

Tretolite Company of California has named W. Wallace Anderson plant manager succeeding C. N. Stehr. Stehr has been given a special assignment for the Petrolite Company.

Anderson has been with Tretolite since 1935. He served in research and development for 11 years and in 1947 became assistant plant manager. Claude D. Thompson will fill the spot vacated by Anderson.

Allis-Chalmers Promotes R. J. Dineen to Manager

R. J. Dineen has been named manager, General Products division sales, Central Region of Allis-Chalmers with headquarters in Cleveland. Dineen will be responsible for the promotion, planning and coordination of sales and the achievement of sales objective through the district offices for pumps, "Texrope" V-belt drive equipment, electrical control and motors. Dineen has been associated with Allis-Chalmers since 1952.

George E. Daniels

William L. Neely

Neely and Daniels Named Rockwell Assistant Treasurers

William L. Neely, assistant controller and George E. Daniels, credit manager, have been named assistant treasurers of Rockwell Manufacturing Company.

Neely has been with Rockwell since 1948 and was promoted to his most recent position in 1952. Daniels joined the company as an accountant in 1949, was promoted to plant accountant in 1951 and credit manager in 1955.

Pfaudler Co. Promotes Gray To Company Director of Sales

A. L. Gray is the new director of sales for the Pfaudler Co., division of Pfaudler Permutit Inc. He will be responsible for the performance of the company field sales organization. Gray will supervise all field sales activities, direct district managers and coordinate sales promotional programs.

A. L. Gray

Gray has been with Pfaudler since 1922, serving in various engineering and sales capacities. He became Rochester district manager in 1949, assistant general sales manager in 1956 and sales manager in 1957.

Royal Joins Sales Department Of M. J. Crose Manufacturing Co.

W. H. Royal has joined the Sales department of M. J. Crose Manufacturing Company, Inc.

Royal has been associated with Browning-Ferris Machinery Co. for the past 11 years. He was assistant sales manager for that company the past three years.

Gardner-Denver Company Announces Promotions of Five Executives

Promotions of five executives in operation of Gardner-Denver Company have been announced. Robert Williams, formerly works manager, has been appointed general plant advisor. A. J. Kathmann, assistant works manager, will assume Williams old position. G. A. Schumacher, formerly superintendent of the LaGrange, Mo., foundry, is now manager of foundry operations, with headquarters in Quincy. E. J. Brown has been raised from assistant superintendent of LaGrange foundry to superintendent. James A. Van Doorn, in addition to duties as manager of facili-

NEW
BORTUNCO BROCHURE

. . . with comprehensive information on how to avoid open cuts in areas of heavy traffic . . . how to eliminate traffic jams, delays, and detours . . . SAVE on total construction costs.

. . . with actual construction shots of boring for municipal and industrial utilities, and

. . . with an impressive list of satisfied customers—contractors, railroads, municipalities, and consulting engineers.

WRITE FOR YOUR COPY NOW!

Texas Tunneling Co.
Horizontal Holes, Inc.
Road Boring & Tunneling Co.
Texas Road Boring Co., of La.-Miss.

subsidiaries of

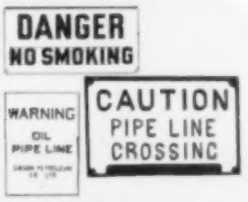
BORING & TUNNELING CO. OF AMERICA

P. O. Box 14214
Houston, Texas
Dallas, Texas
Baton Rouge, La.
Atlanta, Ga.
Kansas City, Mo.

For more data on advertised products, use Readers' Service Cards, last page.

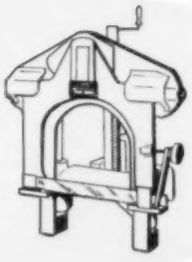
L&M Marker Vents
Aerial Markers
Junction Boxes
Sole Distributors

L&M Dura-Glaze
Aluminum
Plate Signs

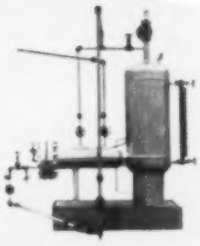


TOPAZ . . . LEADER IN DEPENDABLE PRODUCTS

Guillotine Saws
National Saws
Agent for
E. H. Wachs Co.



Topaz — H&H
Gas Odorizers
Manufactured by
Tod Pazdral



TOPAZ . . . LEADER IN ENGINEERING ASSISTANCE

Stopple
Applications,
Hot Tapping,
Pigging, Bushings
and Insulators
Agent for
T. D. Williamson,
Inc.

TOPAZ . . . LEADER IN FAST SERVICE

Topaz sales engineers will
assist your Engineering Department
and supervise field personnel in solving unusual
pipeline problems. Topaz service includes
furnishing all equipment on a lease,
contract or purchase basis.

ToPaz

TOD PAZDRAL Pipeline Specialties

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For more data on advertised products, use Readers' Service Cards, last page.

ties, has been placed in charged of the company's maintenance divisions.

Williams will serve as consultant on matters pertaining to manufacturing and production in company plants in various parts of the world. He joined Gardner-Denver in 1939 and became works manager in 1947. Van Doorn has been with the firm since 1925 and became plant facilities manager in 1955. Kathmann, who has been with the company since 1945, was promoted to assistant works manager in 1957. Schumacher and Brown have served 10 years with Gardner-Denver.

Walter H. Daub, Jr. Promoted By Pittsburgh Coke & Chemical

Pittsburgh Coke & Chemical Company has appointed Walter H. Daub, Jr., as sales development representative of the company's Industrial Chemical division.

Daub will be transferred from the Philadelphia territory to his new post in Pittsburgh. Donald L. McCuen will succeed him in his present sales assignment. Prior to joining Pittsburgh Coke in 1951, Daub had been associated with Mellon Institute and the Atlas Powder Company.

W-K-M Appoints Butler Assistant Sales Manager

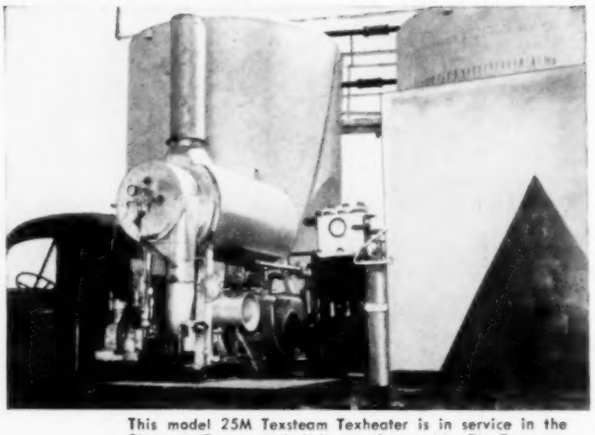
Robert D. Butler has been appointed to the position of assistant to sales manager plug valves for W-K-M. Butler came to W-K-M in 1953 as sales representative plug valves in the southeastern part of the United States. He will be located in Houston in his new assignment under W. A. Gormley, sales manager plug valves.

Versatile

WISCONSIN-POWERED

"Texheater"

gets around in the Oil Fields



This model 25M Texsteam Texheater is in service in the Sherman, Texas, pool. It is manufactured by The Texsteam Corporation, Houston, Texas.

WIDELY used in the oil fields, this versatile heating unit has many applications . . . where quick, sustained heat is required. It is extensively employed to heat oil that is emulsified with water so that the added chemical will be immediately effective. It is also used for heating oil that has a tendency to deposit amorphous paraffin and thus clog up pipelines and connections.

A V-type 4-cylinder Wisconsin Heavy-Duty Air-Cooled Engine provides the dependable power required for operating the compressor that atomizes the fuel oil for heating, as well as circulating the oil or fluid that is being heated or treated. The Texsteam Texheater shown above has a capacity of 2,500,000 B.T.U. per hour and a discharge temperature of 500° F. if required.

A prime requisite for the successful, sustained operation of this unit is, of course, dependable power. A 4-cylinder V-type Wisconsin Heavy-Duty Air-Cooled Engine was specified as original equipment because this engine meets all oil field requirements. Heavy-duty design and construction in all details provides assurance of low cost maintenance, dependable operation and long engine life. Basic High Torque design supplies the load-holding Lugging Power that rides through the shock loads without stalling. Efficient AIR-COOLING at all temperatures from sub-zero to 140° F. eliminates cooling problems and hazards under all weather conditions.

The Wisconsin Engine line includes a complete range of sizes from 3 to 56 hp., in 4-cycle single cylinder, 2- and 4-cylinder models. *All models can be supplied with electric starting.*

You can't do better than to specify "WISCONSIN POWER" for your equipment.

WISCONSIN MOTOR Corporation

MILWAUKEE 46, WISCONSIN

World's Largest Builders of Heavy-Duty Air-Cooled Engines

WRITE TO HARLEY SALES CO.

619 SOUTH MAIN STREET • TULSA, OKLAHOMA
3420 McKINNEY AVENUE • HOUSTON, TEXAS
505 SOUTH MAIN STREET • WICHITA, KANSAS

OIL FIELD DISTRIBUTORS FOR WISCONSIN ENGINES AND ALL TYPES OF UTILITY UNITS

A8-6205-1½I

Richard E. Jenkins

Robert J. Spears

Spears and Jenkins Promoted To Assistant General Sales Managers

Richard E. Jenkins and Robert J. Spears have been named assistant general sales managers for Clark Bros. Co. Spears will supervise the company's eastern district offices of Boston, New York, Philadelphia, Detroit, Pittsburgh and Atlanta.

Jenkins responsibilities will include all offices west of the Mississippi. Spears began his career with Clark 22 years ago in Sales Engineering department. Later he was appointed manager of the company's New York district office. Ralph C. McDonald will succeed Spears in his old position.

Jenkins has been with Clark since 1948. He worked in sales engineering in Los Angeles for six years among the oil, gas pipe line and distributing companies. In 1956 he was named administrative sales manager at Olean.

Ralph Simpson Becomes Sales Manager for Whitmor

Ralph Simpson has been promoted to a newly-created post of sales manager for Whitmor Homebuilders. Previously he was assistant sales manager of the industrial housing firm.

Ralph Simpson

E. R. Blair, Jr., who had been serving as production manager and sales manager, will continue as production manager. Simpson has been active in the building and supply business for the past four years and has been assistant sales manager the past year.

Enardo Mfg. Co. Appoints DeLarzelere Sales Manager

Enardo Manufacturing Co. announces the appointment of Frank DeLarzelere as sales manager. He has 35 years experience in the oil and gas equipment field.

DeLarzelere formerly was vice president of Production Engineering and Equipment Co. He has spent the last two years in research and development work on oil industry automation.

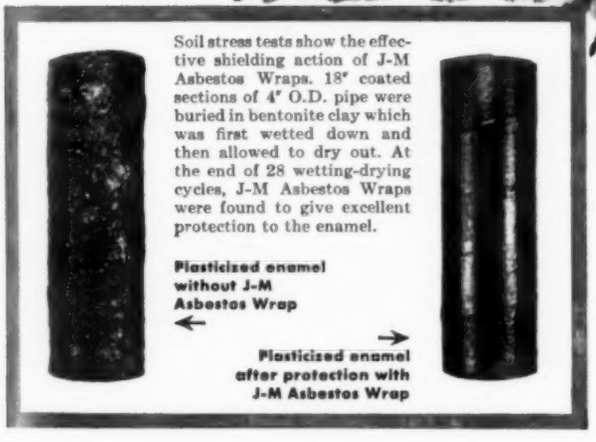
Sawyer, Bradley Appointed By J. F. Pritchard and Company

Frank S. Sawyer has been named manager of construction, and R. H. Bradley succeeds W. H. McKay as Houston district manager for J. F. Pritchard and Company.

Sawyer joins Pritchard with four decades of experience in the construction industry. McKay retired as district manager after 19 years with J. F. Pritchard.

Stop damage to enamels from earth loads and soil movement . . .

Johns-Manville Asbestos Wraps are available in 3 types for field application or mill wrapping.



Soil stress tests show the effective shielding action of J-M Asbestos Wraps. 18" coated sections of 4" O.D. pipe were buried in bentonite clay which was first wetted down and then allowed to dry out. At the end of 28 wetting-drying cycles, J-M Asbestos Wraps were found to give excellent protection to the enamel.

Plasticized enamel without J-M Asbestos Wrap ←

→ **Plasticized enamel after protection with J-M Asbestos Wrap**

Get lasting protection with tough, strong J-M Asbestos Wraps

Extensive research and field tests conducted by a leading firm of consulting engineers have demonstrated the effects of soil movement and earth loads on pipeline enamels. They show how the forces of the soil tend to distort and induce thin spots that weaken the protective coating . . . permit corrosion of the pipeline.

The same research and field tests also demonstrated that J-M Asbestos Wraps provide the strong protection that strong coatings need and deserve. "Asbestos Wraps offer the most effective single protection against damage —prolong the working life of pipeline enamels." Here's why . . .

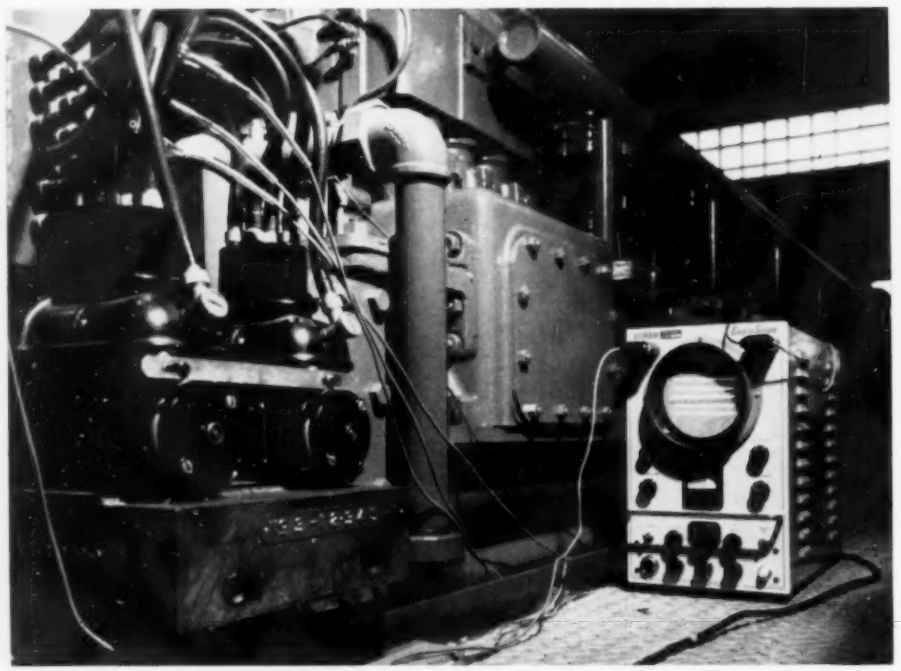
Asbestos is an ageless mineral. Fibers of asbestos are strong and tough . . . cannot rot or decay. As used in J-M Wraps, the fibers are felted, then impregnated with a coal tar or asphalt saturant to form literally a flexible covering of stone. These "stone-like" qualities form a durable shield—protect pipeline enamels from earth loads and soil movement which weaken coatings and permit pipe corrosion to set in.

Pipeline engineers are invited to write for their own copy of PP-34A, a *3-Point Study of Pipeline Coatings and Wrappers*, at no cost or obligation.

Johns-Manville, Box 14, New York 16, N. Y.
In Canada, Port Credit, Ontario

JOHNS-MANVILLE

What's New in EQUIPMENT



Engine Analyzer

DuMont Laboratories, Inc. announces a new oscilloscope engine analyzer for spark ignited industrial equipment which features a multi-line presentation, cylinder by cylinder.

The Enginscope also features the application of a special harness to make possible secondary viewing. The instrument locates troubles instantaneously in any spark ignited industrial engine, whether it be of the magneto or battery type.

The multi-line presentation allows a mechanic to pinpoint troubles by cylinder comparison. Using signal clips on the harness, the instrument may be connected to the engine while it is in operation. The engine pulse is picked up through induction, thereby eliminating the need of disturbing the system or piercing the wires.

For More data, circle **No. E1** on Readers' Service Card, last page this issue.

Mobile Radio

A thermostatically-protected, transistor-powered 100-watt mobile radio is offered by General Electric Company. The radio is designed with automatic cut-off and reset functions which keep the transistor power supply safe against abuse due to heat caused by overload, duty cycle and environmental conditions.

The 100-watt mobile is equipped with a die-cast heat sink of special design. The sink is made of brushed aluminum and serves as an enclosure for power transistors. Engineered for both appearance and performance the equipment assures maximum dissipation of heat from transistors and minimum heat absorption. The bright aluminum surface of the sink provides a high degree of reflectivity of radiant heat from external sources as well as adding to the style of the radio unit.

General Electric is now marketing 30, 60 or 100 watt transistor powered mobiles in 25-54mc.

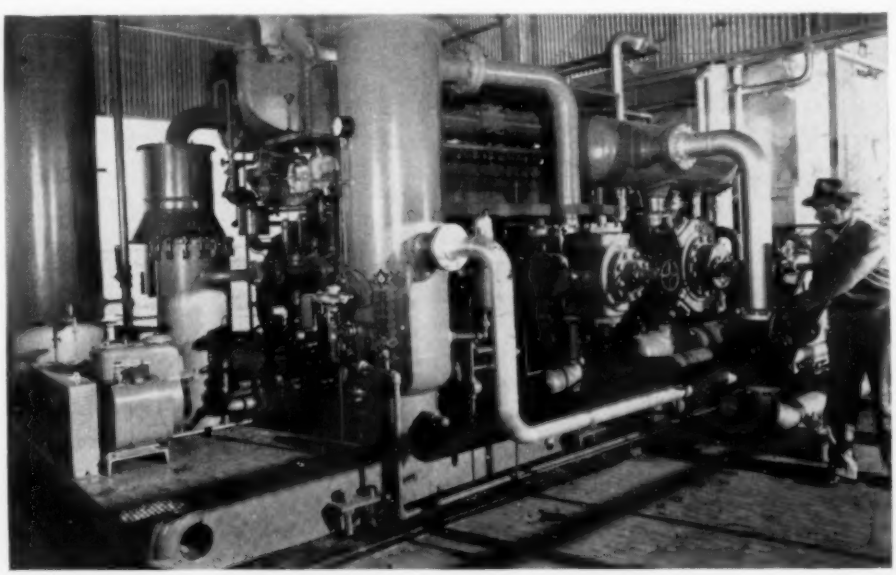
(This item supplements General Electric Company data on Pages 181-188 of the Pipe Line Composite Catalog, 1st Edition). For more data, circle **No. E2** on Readers' Service Card, last page this issue.

Double Drum Winch

A new and improved design for its hydraulically operated "little boomer" sideboom has been announced by Midwestern Manufacturing Company. A double drum winch replaces the two separate winch drums which were formerly used. With the double winch, the operator is in a position to check the condition of cables at all times.

This design also permits a streamlined arrangement of the hydraulic motors and hoses, which provides accessibility for inspection and maintenance. Strength of the sideboom frame and boom has been increased to compensate for the increased lifting capacity provided by this new and heavier John Deere tractor.

For more data, circle **No. E3** on Readers' Service Card, last page this issue.



Skid-Mounted Compressor

A skid-mounted compressor unit, fabricated by the Foor Engineering Company, has been put into operation at Permian Basin's Jal, N. M., station.

The unit is equipped with skids, engine and gas cooling equipment, gas scrubbers and safety controls. Compressor is a 450-rpm Worthington Corporation unit rated at 317 bhp at 3,700 feet.

(This item supplements Worthington Corporation data on Pages 485-488 of the Pipe Line Composite Catalog, 1st Edition.)

For more data, circle **No. E4** on Readers' Service Card, last page this issue.

UNIBOLT – the best way to close a pipeline opening
Unibolt hinged scraper trap and blowdown closures started a new trend . . . away from heavy, multi-bolt blind flanges. Release only two bolts and these modern closures swing open like a door. The self-sealing gasket is oil-resistant, troublefree, long-lasting. Unibolt closures are available in sizes up to 42", ratings to ASA 900.
Write for a copy of the new Unibolt Pipeline Catalog No. PL-570.
THORNHILL CRAVER CO.
P. O. BOX 1184 HOUSTON, TEXAS

Hydraulic Hoe-Shovel

Bucyrus-Erie Company announces an all-hydraulic combination hoe-shovel. The one-half cubic yard hydrohoe-hydroshovel mounts on any new or used suitable commercial truck and can be taken to jobs at speeds reaching 50 mph.

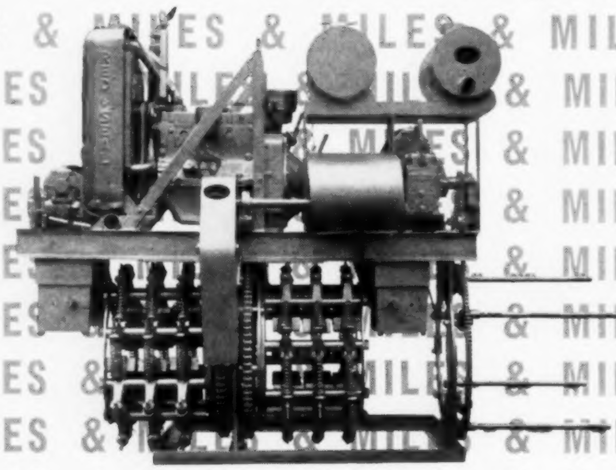
Three hydraulic circuits, each supplied by a separate pump, provide 90 hydraulic horsepower for production work. A solid digging platform is provided by four hydraulically controlled outriggers. A dipper wrist action ram generates as much as 10 tons of digging force at the dipper lip. With boom telescopes up to 4 feet, truck move-ups are reduced and the dipper is spotted easily when working over the side.

Six hand levers and two foot pedals comprise the operating controls located in front of the operator.

(This item supplements Bucyrus-Erie Co. data on Page 60 of the Pipe Line Composite Catalog, 1st Edition.)

For more data, circle **No. E5** on Readers' Service Card, last page this issue.

PROVED BY MILES & MILES



# of Cleaning and Priming on Pipelines all Over the World . . .

- **Line-Traveling or Stationary Yard and Railhead Types**
- **Counter-Rotating Heads to Eliminate Torque Strain on Cradles**

Perrault cleaning and Priming machines are available for pipe sizes from 2" through 36". Model ER features counter-rotating heads for cleaning large diameter pipe with any combination of cutters, knives and brushes from both directions at once. Years of experience in serving the pipeline industry have proved Perrault cleaning and priming machines. Let us prove them to you with a demonstration. Just call LUther 5-1103 in Tulsa.

EVERY THING FOR THE PIPELINER!

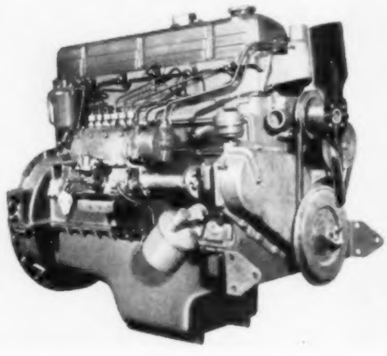
Line Traveling and Stationary Coating and Wrapping Machines, Cleaning and Priming Machines, Pneumatic Clamps. Perrault-American Tar-Heating Kettles, Patchpots, Burners, parts and accessories. Esco Digging Teeth Pipe Protection Materials — Kraft, Asbestos Felt, Glass Wrap and Rock Shield. General Supplies—Hooks, Blocks, Line-Up Clamps, Sling Belts, Cradles, Hand Tools, materials, supplies and equipment of every sort . . . Everything for the Pipeliner.

PERRAULT *Equipment* COMPANY

W. O. DIXON, Sole Owner

TELEPHONE LU 5-1103 • 1130 N. BOSTON • TULSA 6, OKLA.

EXPORT OFFICE: SUITE 1665, 45 ROCKEFELLER PLAZA • N. Y. 20



Gas, Diesel Engines

Introducing four new engines, three gasoline and one diesel, the Ford Division now offers a full line of 10 basic industrial engines with displacement ranging from 134 cubic inches to 534 cubic inches.

The new super heavy duty V-8 gasoline engines feature high turbulance wedge-shape combustion chambers, new fuel injection system and full pressure lubrication systems.

The large dished type valves are faced with tungsten-cobalt alloy for long valve and seat life; exhaust valve stems are sodium filled for better heat transfer and longer life.

The six cylinder diesel features a 12-volt electrical system, replaceable wet cylinder sleeves to eliminate reboring and four way fuel injectors.

New engine models are the 401, 477, 534 cubic inch V-8 engines and the 330 cubic inch diesel.

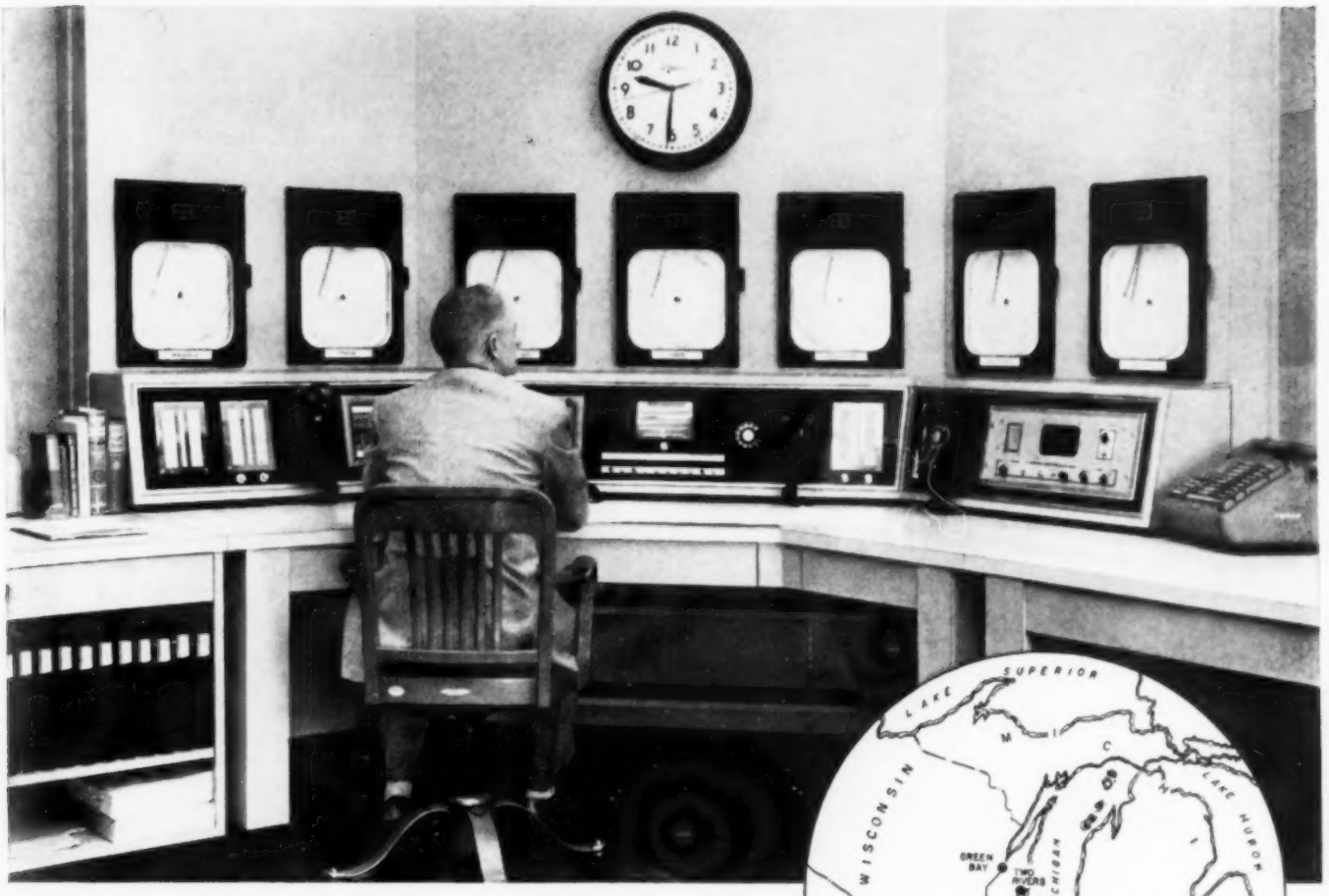
For more data, circle **No. E6** on Readers' Service Card, last page this issue.

Pipe Coating

Permaspray, Inc., announces a furan resin base pipe coating for internal and external protection.

It is a blend of resin-forming liquids in solvents which facilitate its application: it does not deposit a film by solvent evaporation. It hardens by chemical action initiated by the addition of a liquid activator. The coating can be painted with oil base paints or lacquers.

For more data, circle **No. E7** on Readers' Service Card, last page this issue.



BRISTOL METAMETER TELEMETERING Transmitters pick up pressure and differential pressure data from seven critical points on map and send them to central dispatcher's office in Detroit. Fourteen readings are displayed on the seven receivers shown.

Bristol Telemeters provide continuous,

automatic telemetering via privately owned microwave system

The Michigan Wisconsin Pipe Line Company, Detroit, Michigan, operates a 2000-mile Natural Gas pipeline network extending from Texas through nine states. A privately owned integrated microwave and VHF system provides voice and mobile unit communication service throughout the system.

It was a simple matter to add continuous automatic telemetering with Bristol Metameter* telemeters. Bristol telemeter transmitters send pressure readings from six locations in Wisconsin and one point in Michigan to the seven receivers (shown above) in the dispatcher's office in Detroit.

Although two individual voice frequency microwave channels are used for the fourteen readings, up to nineteen pressures could easily be simultaneously transmitted on only one voice channel.

Find out how advanced Bristol telemetering systems can help your pipeline operation – whether over hundreds of miles or only a few hundred yards, whether over microwave or VHF radio, carrier current or leased wires. Ask us for details. The Bristol Company, 114 Bristol Road, Waterbury 20, Connecticut.

*T.M. Reg. U.S. Pat. Off.

8-20

BRISTOL TRAIL-BLAZERS IN PROCESS AUTOMATION

AUTOMATIC CONTROLLING, RECORDING AND TELEMETERING INSTRUMENTS

For more data on advertised products, use Readers' Service Cards, last page.

Ditch Padding Machine

Adaptable to any standard ¾ cubic yard dragline, the Crutcher-Rolfs-Cummings, Inc., ditch padding machine is available for oil, gas and water pipe lines.

The machine is made of an endless steel wire grid, 6 feet wide, rotating on a shaker track system which loosens dirt from rocks in the spoil. A backfill bucket drags the spoil onto the grid which is suspended across the ditch by the dragline boom. Fine dirt is shaken through the grid and onto the pipe while all rocks larger than the grid openings are conveyed across to the working side of the ditch.

(This item supplements Crutcher-Rolfs-Cummings, Inc. data on Pages 107-110 of the Pipe Line Composite Catalog, 1st Edition.)

For more data, circle **No. E8** on Readers' Service Card, last page this issue.

Lined Fittings and Pipe

Unplasticized polyvinyl chloride lined fittings and pipe will be manufactured and marketed by Tube Turns Plastics, Inc., and Swepco Tube Corporation. Swepco will make the pipe and Tube Turns the Fittings.

The Swepcore pipe will normally come with a steel shield with UPVC lined cast iron fittings; cast aluminum and cast steel lined fittings, Swepco with aluminum, stainless steel or special alloy shielding will also be made available. Fittings and pipe will range from ½ inch through 3 inches. The range will be extended as market requirements expand.

The new piping combines corrosion resistance, non-flammability, and non-electrolytic action characteristics of UPVC with strength of metal and improved temperature resistance. Tube Turns UPVC fittings are made of 100 percent pressure tested, controlled cast iron with type 1 UPVC lining molded into the casting by exclusive Hendry Process.

Swepcore UPVC shielded pipe consists of specially tested tube, flared at the ends and having an extruded tube inserted and mechanically attached. The flared ends are joined by means of a special flange employing a patented gasket.

For more data, circle **No. E9** on Readers' Service Card, last page this issue.

Radio Power Control

General Electric Communications Products Department is field testing a power control unit which may reduce some of the communications interference problems.

First tests established, automatically adjusting signal output of base station transmitter so that the signal is not more than needed to reach a specific mobile receiver, were run at a utility headquarters.

The unit is expected to have its greatest value during crowded communication periods when air-waves are jammed with messages from crews called out to repair storm snapped lines.

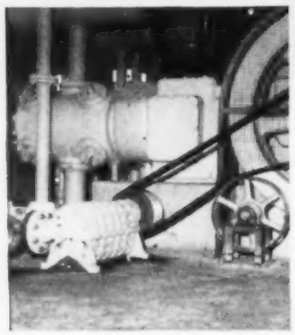
The power control will bring base stations in mobile radio systems into full agreement with the FCC's requirement that only the power needed to perform a service be used.

(This item supplements General Electric Company data on Pages 181-188 of the Pipe Line Composite Catalog, 1st Edition.)

For more data, circle **No. E10** on Readers' Service Card, last page this issue.

ALL-HYDRAULIC

GASOLINE PLANT



Power source for the system are two Berry Pumps driven by the main gas compressor engines. These pumps furnish oil to the hydraulic motors driving the cooling tower fan, raw water pump, treated water pump, boiler forced draft fan, and two ammonia refrigerant pumps.

CHILLGAS ENGINEERING Design Provides Substantial Economies for LLANO GRANDE Corporation

At the Llano Grande satellite gasoline plant all auxiliaries are driven by Berry Hydraulic Pump/Motor Transmissions. This non-hazardous, variable-speed hydraulic system is priced competitively with constant-speed drives—but less expensive to operate. A further advantage—the plant can be operated unattended, since all processes can be controlled automatically by using the infinitely variable speed range of Berry Pump/Motor units.

Write for Technical Bulletins.

BERRY HYDRAULICS

A DIVISION OF OLIVER TYRONE CORPORATION
GENERAL SALES OFFICE OLIVER BUILDING
PITTSBURGH 22, PA

A high-performance crawler excavator

the ALLEN model C16

This British-built ½ cu. yd. machine is one of the latest in the ALLEN range of HIGH QUALITY excavators.

It can swing, hoist, and travel all at the same time, thus reducing working time on many jobs. Smooth, air-controlled clutches give fast working and a high output comparable with many larger machines.

Write for full particulars.

Air-controlled segmental clutches for light handling and easy replacement. All drums and shafts on ball bearings. Power unit—the Gardner 4 LW oil engine. Two forward travel speeds. Can be equipped as crane, clamshell, dragline, shovel or trench hoe.

JOHN ALLEN & SONS (OXFORD) LTD
COWLEY OXFORD ENGLAND

PIPELINES
are in the NEWS

Watch - **WILLIAMS BROTHERS**

ENGINEERS-CONSTRUCTORS

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Washington — Pittsburgh — Louisville
Minneapolis — New Orleans — Caracas
Bogota — La Paz — Edmonton
Calgary — London — Ankara — Tehran

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TULSA
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WILLBROS.

OIL • GAS • WATER • PRODUCTS PUMPING STATIONS AND PIPELINES

Serving the Pipeline Industry
with Lincoln Arc Welding Supplies

BIG THREE
WELDING SUPPLY CO.
is happy to announce their appointment as

WORTHINGTON

DISTRIBUTORS FOR
TEXAS OKLAHOMA NEW MEXICO

PORTABLE ROTARY AIR COMPRESSORS
(Designed for the pipeline industry)

TWIN DRILLS
CONTRACTORS TOOLS AND PUMPS
TURNING TOOLS AND WELDING POSITIONERS

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1717 E. Presidio
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BRANCHES
DALLAS
ODESSA
LUBBOCK
BORGER
EL PASO
LONGVIEW
ALBUQUERQUE
FARMINGTON

C. E. Williams, Gulf Sales Engineer, Midland, Texas, and G. W. Ramsey, Assistant Plant Superintendent, inspect force feed lubricators on one of the modern gas engines at the Goldsmith plant of El Paso Natural Gas Company.

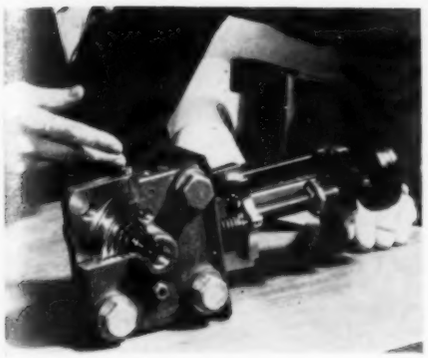
No lubrication problems in 8 years of operation

Since 1949, twenty-seven gas engine-compressor units developing 39,985 horsepower at the Goldsmith plant of El Paso Natural Gas Company have been thriving on Gulf Security Oil. Bearing, ring and cylinder wear maintenance records have been excellent.

Insure safe, more effective lubrication protection for *your* compressor units. Specify Gulf Security . . . the high quality, straight mineral oil. For full information, call your nearest Gulf office.

GULF®

GULF OIL CORPORATION, Dept. DM, Gulf Building, Pittsburgh 30, Pa.



Pressure Transmitter

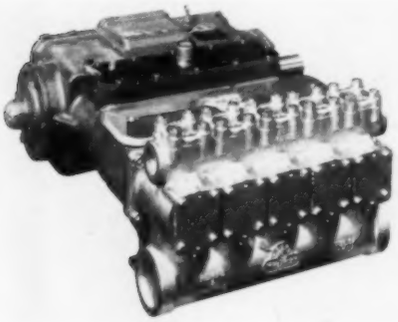
Mason-Neilan announces a differential pressure transmitter with a variety of design refinements developed to assure the best performance for flow or liquid level applications.

Accuracy has been established at 1 percent of range span. Damping is built in at measurement source and distortion due to outside forces acting on the cover is eliminated. Range of the transmitter Model 4811 is adjustable between 20 and 200 inches of water, and suppression up to 100 inches on either high or low pressure side.

An extra heavy beam minimizes bending, and a special secondary beam maintains contact with preload spring to provide over-range protection. Complete protection is provided for the double diaphragm element in event of overload or negative differential.

(This item supplements Mason-Neilan data on Pages 275-282 of the Pipe Line Composite Catalog, 1st Edition.)

For more data, circle **No. E11** on Readers' Service Card, last page this issue.



Plunger Pump

Frank Wheatley Pump and Valve announces an addition to the company's line of plunger pumps. A 3-inch quintuplex pump, designated as the 5P-300, operates at 80 hp developing 500 rpm and producing 4,300 bpd at 3,000 psi.

The pump was achieved by manifolding two additional cylinders to the P-300 triplex pump. The new pump incorporates all proven features of the P-300. Included are 1¼ to 2½-inch plunger sizes; small discharge valves for reducing hammer; large suction valves for positive fillings; hard chrome faced valves; deep stuffing boxes for force-feed lubrication and long packing life; and cartridge type cylinder head stuffing boxes for easy field maintenance.

(This item supplements Frank Wheatley Pump & Valve Mfr. data on Pages 475-478 of the Pipe Line Composite Catalog, 1st Edition.)

For more data, circle **No. E12** on Readers' Service Card, last page this issue.

He's doing it Quickly and Correctly with a

LOWELL #50-A
Reversible Ratchet Wrench

Here's why many major pipe line companies are asking for the new Lowell #50-A Wrench.

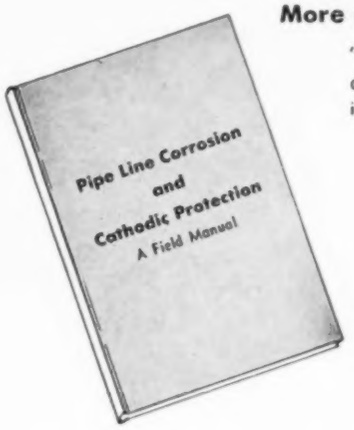
1—The reversible ratchet speeds installation of mechanical pipe line couplings.

2—Its special 8" handle assures correct torque on 5/8" bolts.

Other reversible ratchet wrenches available with handles up to 36" lengths.

Be sure of the right wrench for pipe line jobs . . . ask your industrial distributor for the #50-A or other Lowell Series 50 Wrenches.

LOWELL WRENCH CO.
WORCESTER 8, MASSACHUSETTS



More comments on this new Handbook:

"... a most practical on-the-job manual for men concerned with pipe line corrosion. We are ordering copies for each of our district engineers."

Pipe Line Corrosion and Cathodic Protection

By MARSHALL E. PARKER

This Handbook, written by Marshall E. Parker, consultant, is designed as a practical field manual. It is a 108-page pocket-size volume printed first as a popular series in WORLD OIL. The Handbook is illustrated with many charts and drawings and is completely indexed by subjects.

It presents comprehensive data on Soil Resistivity Surveys, Potential Surveys, Line Currents, Current Requirements, Rectifier Systems, Ground Bed Design, Magnesium Anodes, Stray Current Electrolysis, Interference in Protective Systems, Operations and Maintenance, and Coating Protection and Testing.

An appendix has been added of technical data on Underground Corrosion, Basic Principles of Cathodic Protection, Properties of Metals and Attenuation Equations. Order copies of this practical Field Manual now for each of your field men. Price $3.

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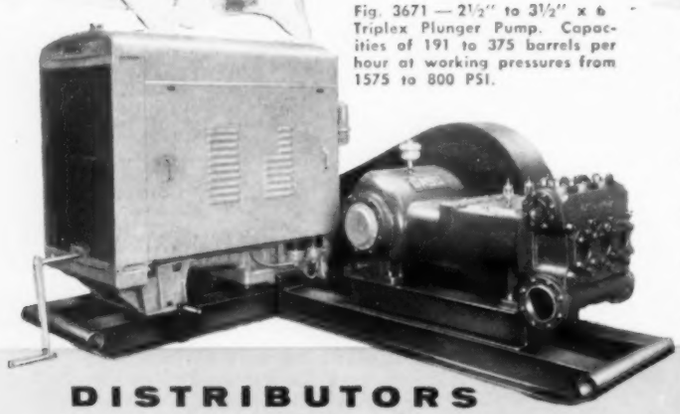

Fig. 3671 — 2½" to 3½" x 6 Triplex Plunger Pump. Capacities of 191 to 375 barrels per hour at working pressures from 1575 to 800 PSI.

Pipe line engineers are practical men. They base their decisions on facts, not impressions . . . and it's facts that have led so many of them to adopt GASO Pumps as standard in their capacity range. *Recorded* facts which show that GASOS consistently outperform and outlast ordinary pumps, and therefore deliver more value per dollar. Ask for latest catalog.

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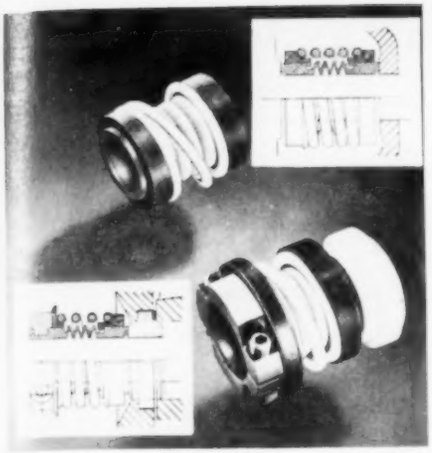


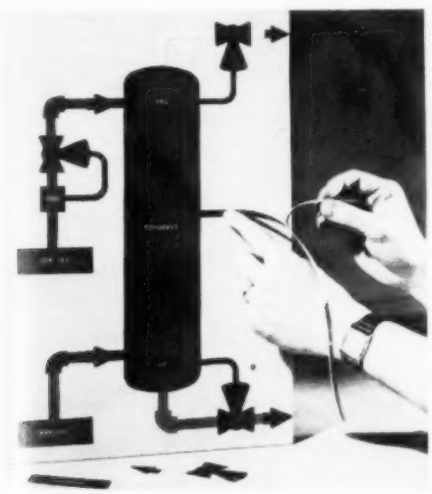
Shaft Seal

A new bellows-type end-face shaft seal has been announced by the Crane Packing Company. The seal is especially designed for use where potent chemicals increase the corrosion rate of seal parts normally made of metal, thereby decreasing its efficiency, and where chemicals prone to crystallization will sometimes inhibit the flexibility of a shaft seal.

The main sealing part of the unit is a bellows of pure Teflon integrally molded with a sealing face of filled Teflon. The sealing face material and the opposed mating face material can be varied to suit specific liquids, temperatures and pressures.

For internal mounting, a double-ended seal is employed—sealing face integrally molded to both ends of the Teflon bellows. The entire assembly is floated between the opposed sealing faces. A single faced seal is used with a rotating member secured to the shaft with a metal clamping ring for external mounting.

For more data, circle **No. E13** on Readers' Service Card, last page this issue.



Graphic Symbols

Pressure-sensitive graphic symbols that simplify panelboard manufacturing are now being used by Panellit, Inc. The economical symbols, which reduce cost from 15 to 20 percent are used on panel-boards designed for automatic control and information systems produced by the firm.

With use of these symbols modification of graphic or semi-graphic presentations can be made with kits which include lines, arrows and other graphic symbols necessary.

The plastigraphic symbols are available in a wide range of colors and can be applied on painted steel or aluminum panels. The flexibility of the material also makes it handy for making preliminary mockups in the design stages.

(This item supplements Panellit, Inc., data on Page 321 of the Pipe Line Composite Catalog, 1st Edition.)

For more data, circle **No. E14** on Readers' Service Card, last page this issue.

Mobile Air Compressor

A portable air compressor rated at 1,200 cfm of free air compressed to 100 psi has been developed by Le Roi Division, Westinghouse Air Brake Co.

The large capacity compressor is ideal for providing air power for pile driving, four-drill pipe line rigs, multiple drill shaft jumbos, air drilling in the petroleum industry or stand-by plant air.

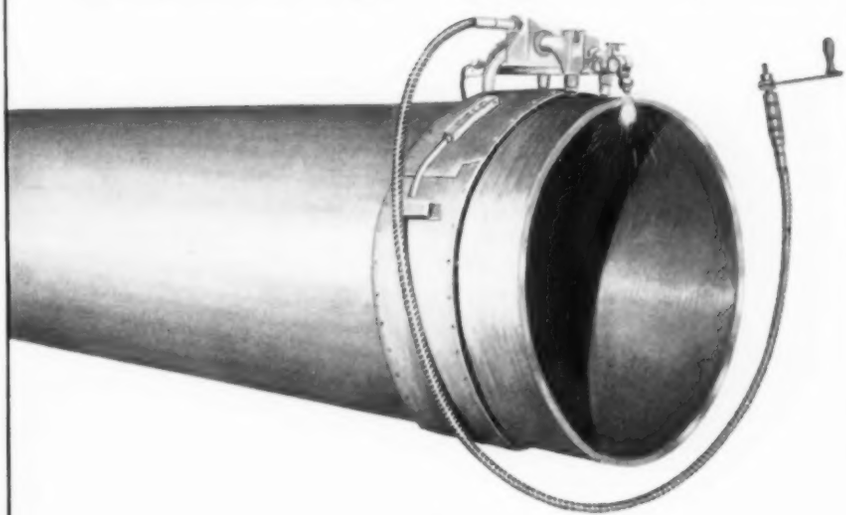
The twin-unit design of two stage, oil cooled, sliding vane type compressors is powered by GM 6-71 diesel engines. The unit operates at rated speeds of 1,800 rpm for the compressors and 200 rpm for the engines. Compressors are coupled to the engines with hydraulically actuated clutches; each unit has a 100 percent capacity control which matches air supply to air demands within a pressure range of 10 psi.

(This item supplements Le Roi Division, Westinghouse Air Brake Co. data on Pages 261-264 of the Pipe Line Composite Catalog, 1st Edition.)

For more data, circle **No. E15** on Readers' Service Card, last page this issue.

BEVELS 6" PIPE

BEVELS 48" PIPE



C-R-C IMCO BEVELERS fit all pipe sizes 6" to 48" O. D., cut perfect bevels, and out-of-round pipe, too. Single lightweight unit does work of several, costs you less to buy and use.

ONE BEVELING KIT FOR ALL YOUR JOBS!

For additional information see page 108, Pipeline Composite Catalog.

The CRC IMCO Pipe Beveling Kit contains a complete range of bands for beveling a variety of pipe sizes. With this convenient selection of sizes, the operator need only make one trip to handle all pipe beveling requirements including back beveling. The sturdy steel case and number of bands are optional.

CRC

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Lube oil cooler maintenance. Oakite Compound 85 does double duty — removes both grease and scale in a single operation. Units go back on stream faster, and at full rated capacity.

Cleaning electrical equipment. For maintenance of generators, control panels and electric motors, Oakite Composition 117 is the specific-purpose solvent with the two essential qualities you want: high flash-point and quick loosening of soil.

These and similar operations at pipeline pumping stations are discussed in a new Oakite Service Report, B6878. For a free copy of this helpful report, write to Oakite Products, Inc., 51A Rector Street, New York 6, N.Y.

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New Equipment Literature

For more data on New Equipment or copies of Catalogs and Literature reviewed in this issue, use the Reader Service postcards just inside the back cover and facing the Advertisers Index. Simply circle code numbers of items desired—sign and mail card.

Pipe Coating Machine

A portable coating machine, capable of coating pipe up to 12 inches in diameter, is described in a four-page bulletin by Royston Laboratories, Inc. The Roskoter can be operated by two men and can be adjusted to apply any desired thickness of coating.

The Roskoter is a hollow cylinder with coating shoes at both ends. The cylinder is hinged so that it can be easily put on and taken off the pipe. Simple catches hold the Roskoter together, and pieces of heavy-duty carpet snap into the coating shoes at the ends of the cylinder. A large trap door on top of the cylinder is used for easy filling and emptying.

Available in three sizes, it will coat pipe from 1½ inches to 12 inches. The coating is applied as the Roskoter is pulled along the length of the pipe. It can also be worked in reverse to simplify a double-coating job.

To get a copy, circle **No. E16** on Readers' Service Card, last page this issue.

Packaged Compressors

A highly illustrated eight-page brochure on packaged compressor plants is offered by Stearns-Roger Mfg. Co.

Explained in detail in the brochure, the compressor plants are adaptable to gas gathering service requiring compression; gas boosting for entry into transmission line or processing plant; conservation through gas compression station to avoid flaring; gas lift operations to increase oil production; pressure maintenance to stabilize oil or gas production; and gas plants for compression in processing functions.

Drawings of the component parts of the packaged plant are shown and specific features of the compressors are listed.

To get a copy, circle **No. E17** on Readers' Service Card, last page this issue.

Why Welded Valves?

Advantages of welded steel valves are explained in an eight-page illustrated bulletin issued by Vereinigte Armaturen-Gesellschaft, of Mannhein, Germany.

The bulletin explains the principles of the flexi-wedge valves, elita valves. Also contained in the brochure is a table listing the working pressures for different type and size valves. VAG equipment described in the brochure includes all size valves for pipe lines and gate valves for tankers.

To get a copy, circle **No. E18** on Readers' Service Card, last page this issue.

Liquid Depth Gages

Petrometer Corporation has issued a bulletin on industrial liquid depth gages which can be used for accurate measurement of liquid depth in storage tanks.

The hydrostatic system of liquid depth measurement consists of five parts. The indicator proper, a well type manometer with accessories to indicate depth; tank assembly unit, pick up device for the system; copper tube transmission line connecting air bell tank unit to liquid well in indicator; an equalized line and source of compressed air to purge transmission line.

To get a copy, circle **No. E19** on Readers' Service Card, last page this issue.

Plastic Pipe Case

Jones & Laughlin Steel Corporation has issued a four-page pamphlet containing information concerning a newly-developed rigid plastic pipe encased in a steel jacket.

"Jal-Jacket" is the name of the case, which combines pressure-retaining strength of steel pipe with chemical resisting qualities of unplasticized polyvinyl chloride pipe.

Specifications, drawings and other pertinent information is contained in the pamphlet. The jacket is expected to be widely used in the pipe line, petroleum and chemical industries and in other fields where corrosion is a problem.

To get a copy, circle **No. E20** on Readers' Service Card, last page this issue.

Submerged Arc Welding

Complete description of Lincoln Electric Company's mechanized squirt welder for submerged arc welding is given in a six-page brochure. The semi-automatic hand welder, used for hand welding, low volume jobs and many other applications, is illustrated in action in the booklet.

The handy machine is explained with an illustrated breakdown of its component parts. Economy, quality and workmanship of the tool are pointed out in the two-color publication.

To get a copy, circle **No. E21** on Readers' Service Card, last page this issue.

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are adaptable for use in nearly all makes of large stationary engines . . . both main and crank bearings.

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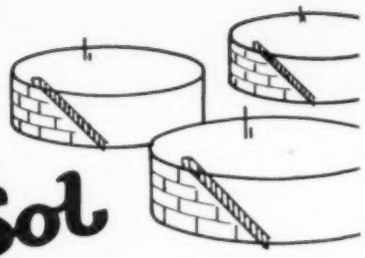

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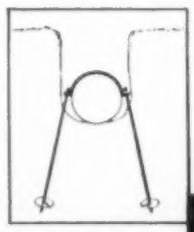
Chance Pipe Line Screw Anchors can be installed in pipe line ditches without extra digging. Using a power wrench the operator merely guides the anchor in place. The tool does the work



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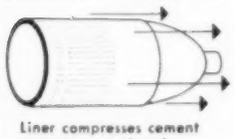

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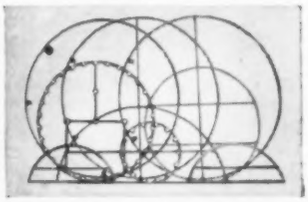

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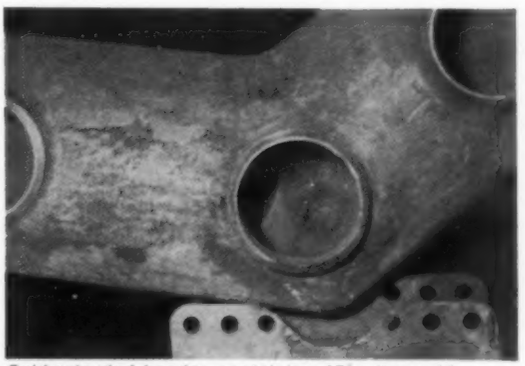
Alloy steel header, with cold-extruded nozzles



Cold-extruded header, containing 45° miter weld

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Simple, more accurate fit-up . . . smoother nozzle contours . . . elimination of reinforcing pads assure important savings

WHEN YOU specify a multiple outlet header, cold-extruded by the new Fluor technique, you obtain a prefabricated piping assembly that offers higher strength, closer dimensional tolerance, smoother surface and greater uniformity.

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IMPROVED FIT-UP: Because of uniformly closer dimensional tolerances for each outlet nozzle, fit-up to adjoining piping is simple, accurate.

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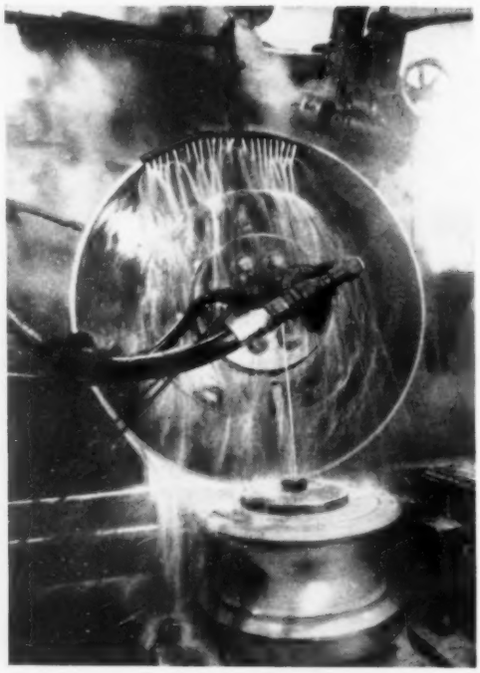

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Joe Roughneck, of course, is symbolic of the men who have made the fabulous oil and gas industry tick . . and Lone Star Steel's huge, completely integrated plant is right in the middle of Joe's workshop. Lone Star pipe is quality-controlled from mining of ore to finished pipe. In addition to operating day and night to supply Joe's pipe needs . . Lone Star has recently completed new and even larger facilities.

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